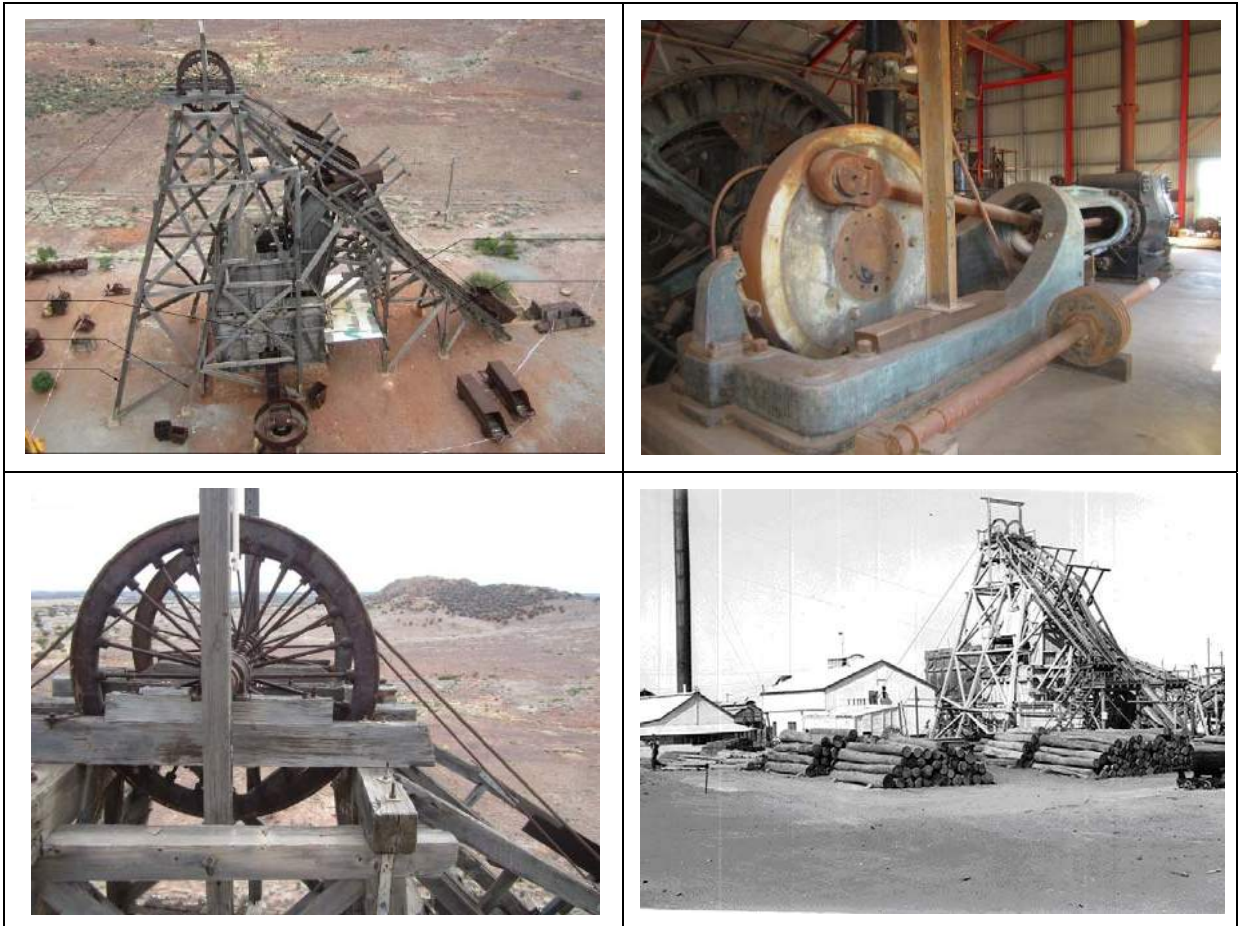


# ENGINEERS AUSTRALIA

## Western Australia Division



### NOMINATION OF SONS OF GWALIA HEADFRAME AND WINDER ENGINE FOR ENGINEERING HERITAGE RECOGNITION



**PREPARED BY ENGINEERING HERITAGE WESTERN AUSTRALIA  
ENGINEERS AUSTRALIA  
WESTERN AUSTRALIA DIVISION**

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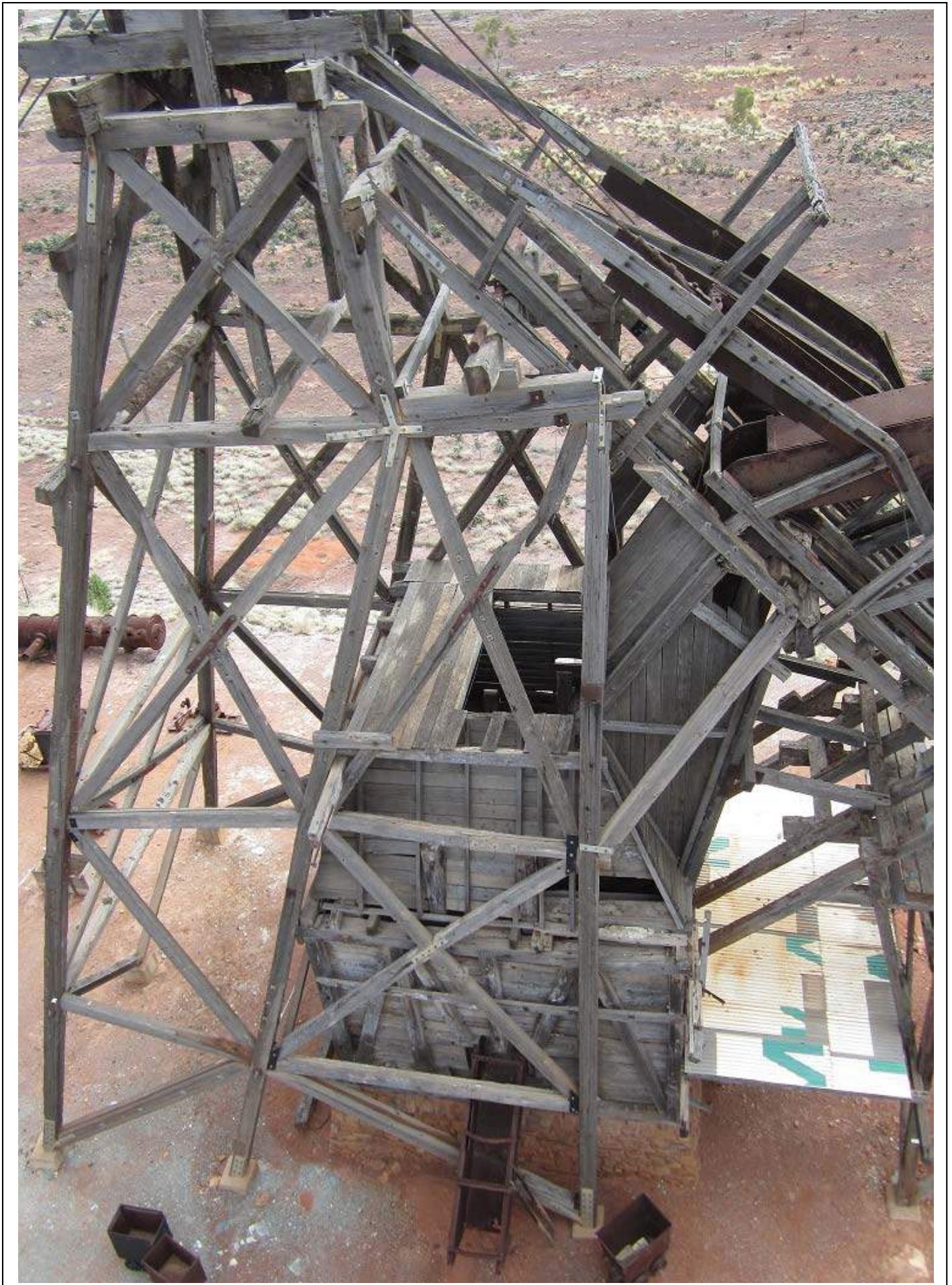


Figure 1

## **1.0 INTRODUCTION**

### **1.1 History of Gold Mining in Western Australia**

Until the 1870s the economy of Western Australia was based on wheat, meat and wool. A major change in the state's fortunes occurred in the 1880s when gold was discovered and prospectors by the tens of thousands swarmed across the land in a desperate attempt to discover new goldfields.

The first gold rush occurred in 1885 when Charles Hall discovered alluvial gold in the Kimberley area. Quickly, further alluvial finds occurred across the state. In many cases, the boom was short lived with towns and mines disappearing fast once the surface deposits were depleted. Only where companies developed underground mines did towns survive.

Paddy Hannan's discovery at Kalgoorlie and the earlier discoveries at nearby Coolgardie, sparked the gold fever.

In the late nineteenth century there was talk of the gold-rich regions around Kalgoorlie leaving the colony of Western Australia and becoming a state called Auralia if Western Australia did not join the Commonwealth. By 1900, more than a third of the state's population was located in the Goldfields. The political influence of this population was demonstrated when the Goldfields threatened to secede, should Western Australia not join the Australian Federation.

Gold production reached its first peak in 1903, with over 50 tonnes of gold produced annually. Production gradually fell to reach a first low in the late 1920s. At that point, Western Australia was almost the only state in Australia to still produce gold. Production rose once more during the Great Depression, to reach a second peak in 1939.

After a short slump during the war, gold production remained relatively steady until the mid-1960s. From there, it fell to levels not seen since the late 1890s, to reach a low point in 1976. It remained low until the mid-1980s, when a new gold boom hit the state.

By 1990, production hit 150 tonnes of gold per year, three times the previous peak of 1903. It reached an all-time record in 2001 with close to 250 tonnes of gold produced that year, being 10% of the world's output.

### **1.2 Sons of Gwalia Underground Mine**

The Sons of Gwalia reef was discovered in April or May 1896. Production and settlement by Europeans immediately commenced and the twin towns of Leonora and Gwalia became established and were connected by Railway to Kalgoorlie and Coolgardie, 250 km to the South.

Apart from the year 1922 following a disastrous fire which destroyed the greater part of the surface plant, the mine remained in production continuously up to 1963, when it became uneconomic and was closed.



### **1.3 Gwalia Museum Group**

In 1971 the Leonora Tourist Committee was formed by the Shire of Leonora.

Soon thereafter the Gwalia Museum Historical Society was formed. The museum was established and continues to this day. The museum's collection includes the timber headframe, winder engine, mines office, assay building, mine superintendent's house, and many artefacts associated with the mine such as skips, kilns, and gold bar moulds.

The headframe and winder engine are the most significant items in the collection.

### **1.4 Sons of Gwalia open cut mine**

When the price of gold rose in the 1980's, a new company, Sons of Gwalia NC was established and open cut operations commenced on the site of the former underground mine. The mine is still operating. The owner is St Barbara. It does not form part of this nomination.



Figure 2

## 2.0 STATEMENT OF SIGNIFICANCE

The Sons of Gwalia headframe and winder engine have cultural heritage significance for the following reasons:

- The headframe and winder engine form part of the Gwalia Museum Group which:
  - is a part of the mining town of Gwalia, the establishment of which was a direct result of the operation of the Sons of Gwalia mine, one of the major underground goldmines in Australia
  - is valued by the local and wider communities for its associations with the early goldmining history of the towns of Leonora and Gwalia, and for its ongoing value as a tourist attraction, as evidenced by the efforts of the local community in restoration, preservation and presentation of the group
  - presents a unique cultural environment in close proximity to a modern mining operation and contributes to a greater understanding of the mining operations of 1898 to 1963
  - has a landmark quality demonstrated by the visual impact of the Headframe from many positions around the towns of Gwalia and Leonora, both by day and by night, when it is flood lit
  - contains items which provide an outstanding opportunity for interpreting the working, commercial and domestic life of a mining town on the eastern goldfields from the late nineteenth century to the present time.
  - presents the past lifestyle to former residents and their descendants who return to see where and how family members lived and worked.
- the headframe is the only large timber underlie, or incline, surviving in Australia. It is one of only five large remaining headframes now in the country, and the largest of three in Western Australia.
- the 1912 Fraser & Chalmers Winder Engine is the largest of its type in Australia and one of only three surviving. It is a fine example of a large, steam-powered winding machine and an example of technological achievement of the period.
- the headframe had a short, but significant, association with Herbert Hoover, later a President of the United States of America, who advised his employer, Bewick Moreing, to purchase the Sons of Gwalia mine, and who was manager of the mine in 1898.

### **3.0 LOCATION**

The geographical locations of the headframe and winder engine are illustrated in figure 3.

They form part of the Gwalia Museum Group, located 4 km South of the town of Leonora.



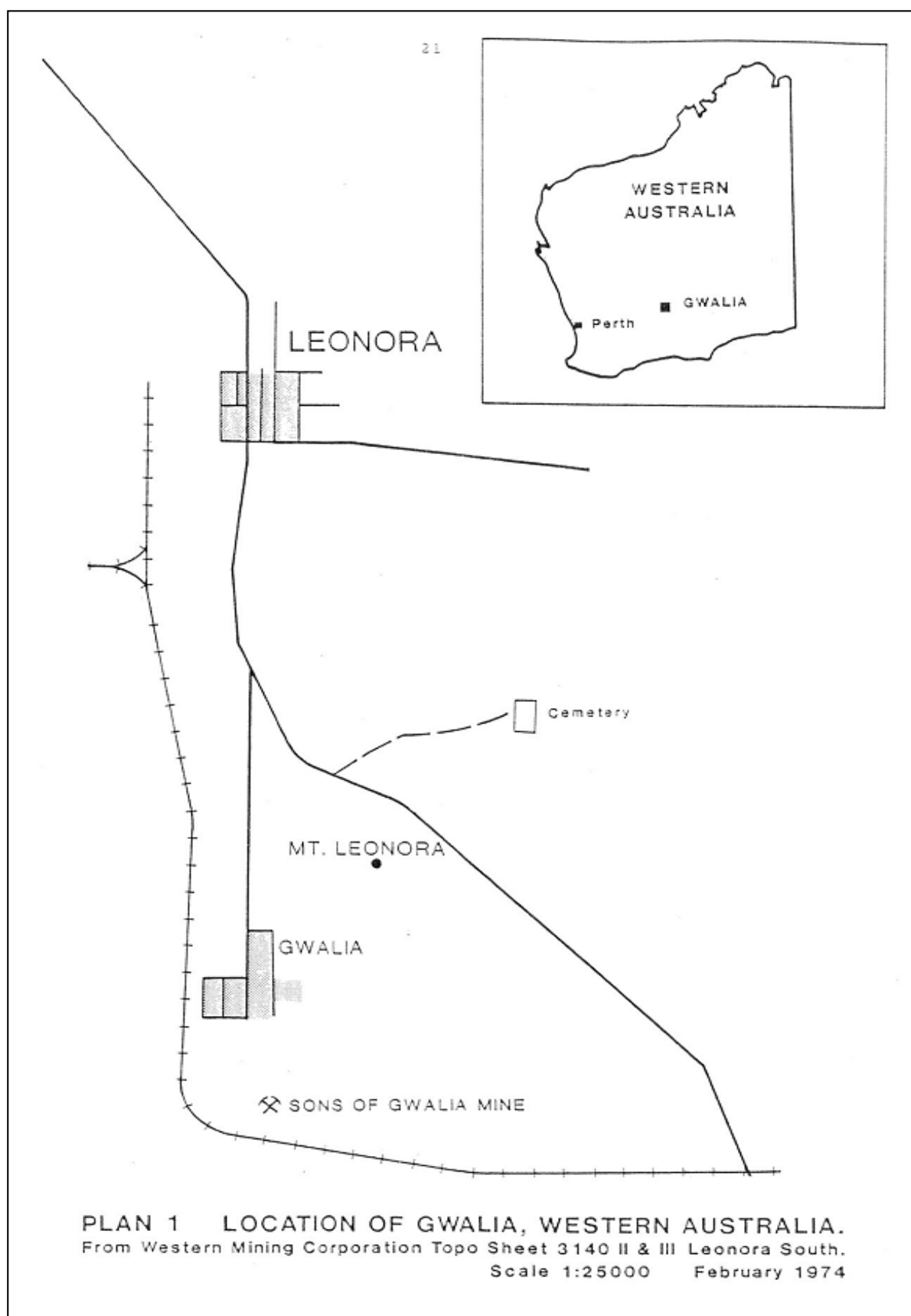


Figure 3 - Location Plan

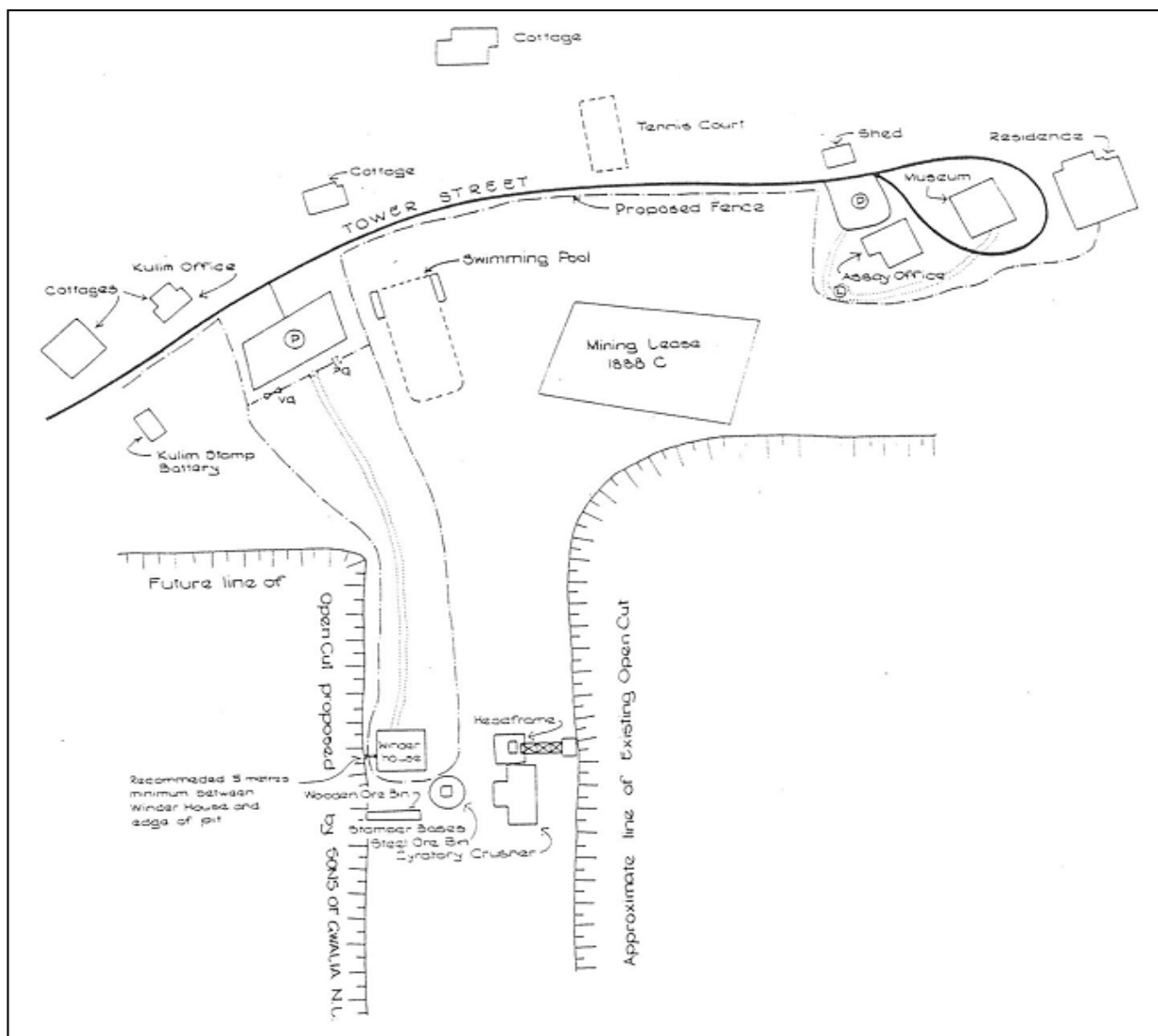


Figure 4 - Site Plan 1985

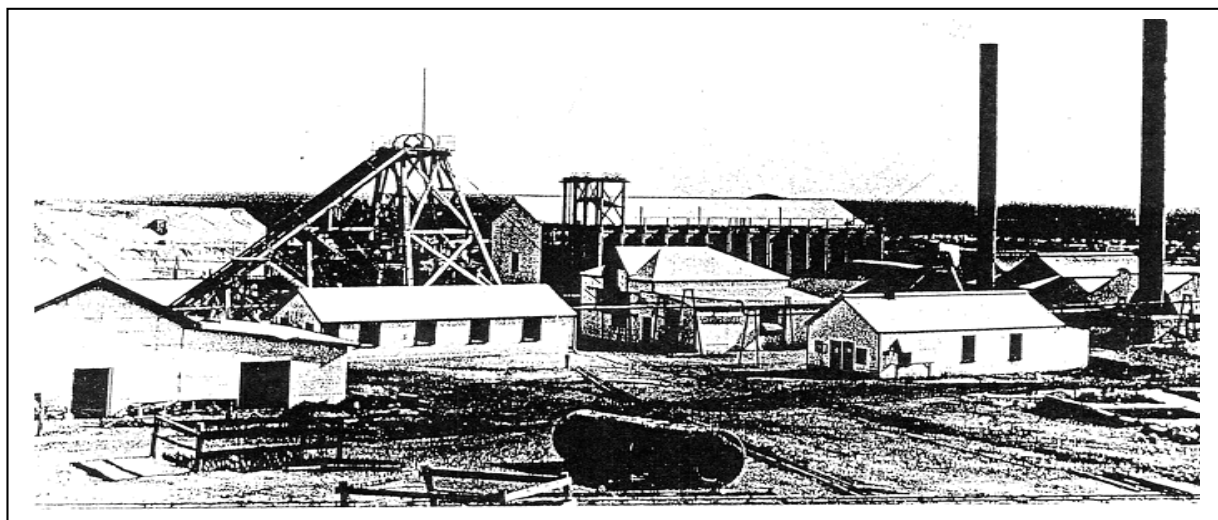


Figure 5 - The Mine in 1903

#### 4.0 HERITAGE RECOGNITION NOMINATION FORM

The Administrator  
Engineering Heritage Australia  
Engineers Australia  
Engineering House  
11 National Circuit  
BARTON ACT 2600

**Name of Work:** Sons of Gwalia Headframe and Winder Engine

The above-mentioned work is nominated for an award under the terms of Engineering Australia's Heritage Recognition Programme.

**Location, including address and map grid reference:**

Form part of the Gwalia Museum Group  
Tower Street, Gwalia  
28° 50' S, 121° 30' E

**Owner (name & address)**

Shire of Leonora,  
Tower Street,  
Leonora WA 6438

The owner has been advised of this nomination and therein letter of agreement is attached.

**Access to sites:**

Tower Street, Gwalia

**Nominating Body:** Engineering Heritage Western Australia, Engineers Australia, Western Australia Division.

Ian Maitland

Chair  
Engineering Heritage Western Australia



Figure 6 – Headframe – Deteriorated timber (2013)



Figure 7 – Headframe – Interior View (2013)



Figure 8 – Winder Engine (2012)



Figure 9 – Winder Engine (2012)



Figure 10 – Headframe and skips (1911)

## **5.0 OWNER'S LETTER OF AGREEMENT – SHIRE OF LEONORA**

Letter from J. P. Epis, Chief Executive Officer, Shire of Leonora, agreeing to the nomination follows.





20<sup>th</sup> October, 2014

The Administrator  
Engineering Heritage Australia  
Engineers Australia  
PO Box 6238  
KINGSTON ACT 2604

Dear Administrator,

**RE: SONS OF GWALIA UNDERGROUND MINE HEADFRAME AND WINDER ENGINE  
NOMINATION – ENGINEERING HERITAGE RECOGNITION PROGRAM**

I have been advised by Mr Ian Maitland, representing Engineering Heritage Western Australia, that it is their intention to nominate the above structures for consideration under the Engineering Heritage Recognition Program.

I am pleased to advise that Members of Council wholeheartedly support the nomination and of course would host a ceremony at the headframe location if the nomination was successful. In addition, and if the nomination is successful, the Shire of Leonora is prepared to provide all the assistance required, to ensure that celebrating the recognition of this important engineering heritage is successful.

A Management Order in favour of the Shire of Leonora was issued on the 9<sup>th</sup> September, 2010. Reserve 46751 includes Leonora Lots 1127 and 1128 both on Deposited Plan 188906.

The Shire of Leonora is the Management Body with the Reserve being created to be utilized for the designated purpose of "Historic Precinct" only.

I know it is only early in the nomination stage but if additional information is required please contact me.

Yours faithfully,

**J.G. EPIS**  
CHIEF EXECUTIVE OFFICER



Figure 11

## **6.0 HISTORIC SUMMARY**

### **6.1 Sons of Gwalia Underground mine 1896 - 1963**

The Sons of Gwalia reef was discovered in April or May 1896 by prospectors Carlson, White and Glendinning, who were backed by the Tobias Brothers, merchants of Coolgardie. The new find was only one of a number of reefs opened up on the Mount Leonora district in that year, but was to prove by far the most significant. It was a good time to find a major gold deposit. The success of Coolgardie and Kalgoorlie had established Western Australia's credentials on international stockmarkets at the very time when economic depression was making gold one of the more attractive avenues for investment, and promoters were scouring the goldfields in search of prospects. Normally, the vendors of mineral deposits face a long struggle to secure capital backing, but Western Australia in 1896 was seething with capitalists awaiting opportunities.

The syndicate registered lease 190 C over the obvious outcrop on 2 June 1896, and by September had commenced small-scale extraction from a vertical shaft. The hole was still less than twenty feet deep when they were visited by George W. Hall, an engineer who had links with the London and Westralian Mines and Finance Agency. Hall obtained an option over their 24 acre lease and took samples back for assay at his mine at Malcolm. He proceeded to Coolgardie where in August 1896 was offered 5,000 pounds in cash for the property. The syndicate accepted with alacrity, for 1,000 pounds per man was a splendid return for a few months' work. Hall, too, was content with the transaction, although even he could not have dreamed that his new reef would eventually yield gold worth over ten million pounds at the 1896 bullion price.

Hall equipped the mine with a second-hand ten head gravity stamp mill by May 1897, and began production early in June. The surface ore was rich, and the first parcels, undoubtedly hand-picked, yielded an average 2.8 oz to the ton. Hall's first month of crushing produced 2,000 ounces, recouping his entire capital investment, and from July 1897 the Sons of Gwalia was paying its own costs and earning a profit. Having proved the mine's potential, Hall sought further capital to back its large-scale development. He attracted the attention of Bewick, Moreing & Coy, a London-based firm who were expanding their interests throughout the Western Australian goldfields.

Their resident Coolgardie partner, Edward Hooper, cursorily inspected the Sons of Gwalia and sent a young American mining engineer, Herbert Hoover, to prepare a thorough evaluation. Hoover arrived at the mine in August 1897, and submitted his report to Bewick, Moreing the following October. By that time the shaft was down to 175 feet, and several hundred feet of drives had opened up the lode.

The main reef was found to dip uniformly at about 45°, and to maintain its grade with depth. In addition, there was a second parallel reef in the formation with values up to 10 oz to the ton, and an extensive zone of lower auriferous values in the host rock. There were 40,000 tons of ore proven.

Hoover had no doubts about the long-term value of the property, and recommended systematic extraction, and construction of a much larger treatment plant. He also had firm ideas about whose hands should control the enterprise, for in recommending acquisition of the Sons of Gwalia, he also personally demanded "entire management" of designing the mine plant.



These were brave words for a twenty-three year old engineer on his first real job, but they had their effect. The Sons of Gwalia was purchased by the London and Western Australian Exploration Company Ltd. On 17 November, and preparations were made to float the property in London. The company's principal was C. Algernon Moreing, and at the end of 1901, Hoover was made a partner in Bewick, Moreing, giving him a share in its interests, the largest of which promised to be the Sons of Gwalia.

In January 1898, the new company, Sons of Gwalia Ltd., was launched in London. Most of its capital of 300,000 pounds was issued to the London and Western Australian Exploration Company to acquire the property, with smaller parcels going to a consortium of companies: the London and Westralia Mines and Finance Agency, the British Westralian Mines and Share Corporation, and the Union Financial Syndicate. Bewick, Moreing had boosted the property vigorously in the mining press, and the few shares that were available to the public sold at over two guineas, more than twice their face value, on the first day of trading. Besides holding the controlling financial interest, Bewick, Moreing were engaged as managing consultants at the mine, and Hoover was appointed General Manager there from 1 May 1898.

Having demanded a free hand in planning the mining and treatment processes, Hoover set about assessing the situation. He had inherited a mine with a vertical shaft down to about 200 feet, employing 150 men. The small and inefficient mill had crushed nearly 9,000 tons of ore and yielded over 12,000 oz of gold. All indications were that the reefs extended to great depth, and long-term production must be planned, which radically altered the emphasis of operations from maximising profits, which had been the old company's policy, to development. In a harsh climate, seventy miles from the railhead at Menzies, and faced with high material and labour costs, Hoover saw that this critical task was to reduce production costs by any means at his disposal. "No other lode in the world", he claimed, "presents such an array of severe conditions which must be struggled against to do cheap mining." Within days of his arrival, he calculated that he could cut production costs by a third. Estimating total expenditure on mining and milling under his new regime, he reported to Bewick, Moreing: "I have put this at 1 pound per ton. The past cost has averaged 30/-, but I think I can lower it much."

To bring about this saving, Hoover had first to subdue his workforce. Only days before he took over the management of the mine, a mass meeting of miners had formed a local union.

It is difficult to believe their timing was coincidental; perhaps word about Bewick, Moreing's management style had spread from other goldfields. Hoover met the union head on.

TO ACCOMPANY REPORT ON THE BOTTOM LEVELS, PARTICULARLY AS REGARDS THE BLANK IN THE GWALIA SOUTH SHOOT BETWEEN THE 16 & 21 LEVELS & THE OCCURENCE OF BARREN QUARTZ (QUARTZITE) AT THE 23 & 24 LEVELS.

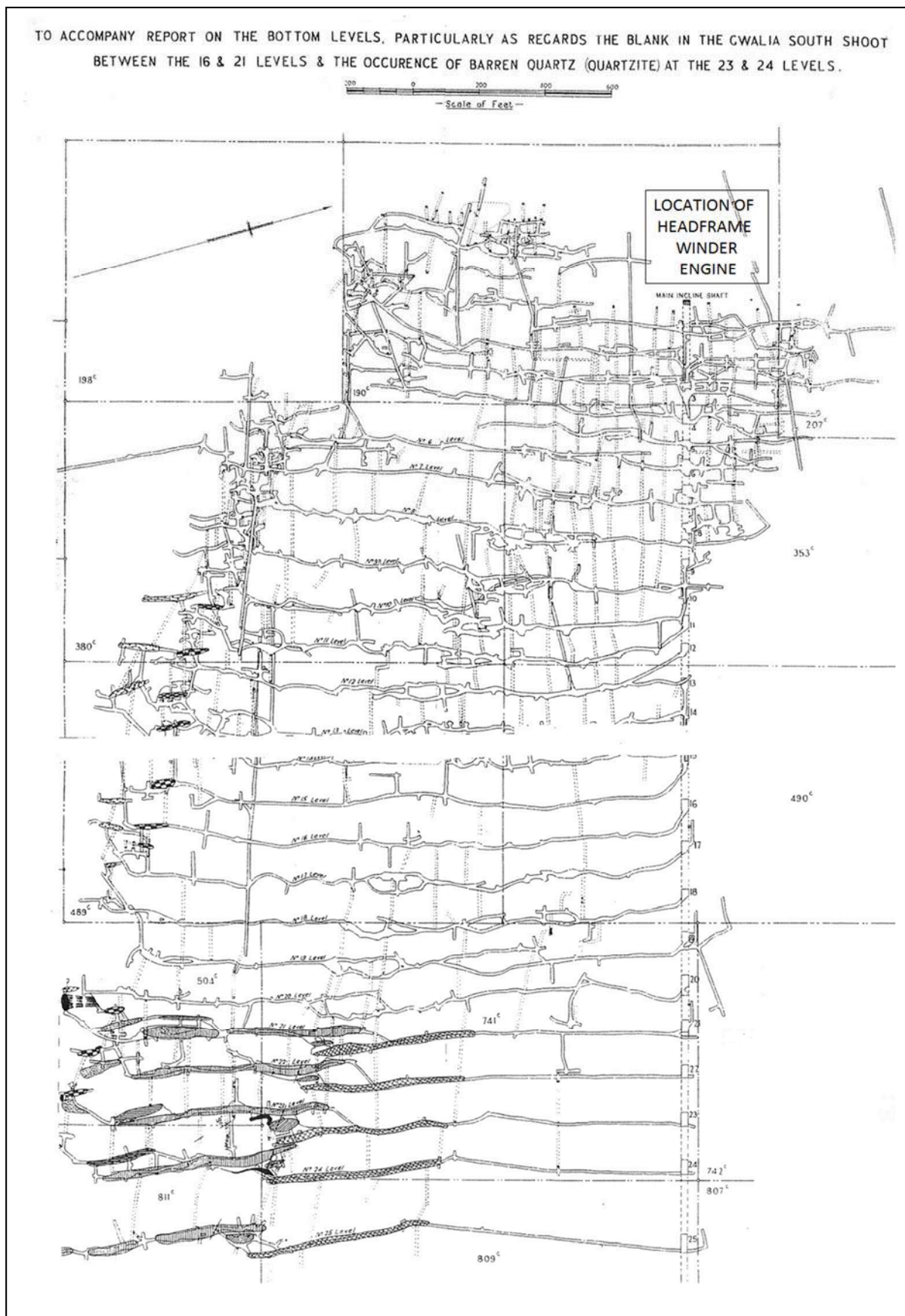


Figure 12 - Mine Layout Underground in 1930

The original diagram came in two sheets. These have been connected together to form this figure, however some detail between levels 14 and 15 was missing.



In his first four weeks as General Manager, he increased the working hours from 44 to 48, introduced single-hand work, instituted shift changes at the working face instead of the surface, stopped double time on Sundays and bonuses for working wet ground, brought in piece-work shaft-sinkers, apparently sacked the union organizers, and was contemplating a general wage cut. All this he achieved.

Hoover's cost cutting strategy took two main directions: to convert labour to a contract basis wherever possible, and to minimize dead work - unproductive sinking and driving - in the mine. In achieving the first aim, Bewick, Moreing had been impressed with the qualities of Italian miners on other Western Australian fields, and Hoover contracted a labour agent, Pietro Ceruti of Bardoc, who provided a steadily growing workforce of Italian contract miners for the Sons of Gwalia. Hoover explicitly regarded them as his allies against the union: "I have a bunch of Italians coming up this week and will put them in the mine on contract work. If they are satisfactory I will secure enough of them to hold the property in case of a general strike, and...will reduce wages." There was no general strike, and Hoover's heavy hand continued to dominate industrial conditions, but he had also founded the Italian community which was to characterize the town of Gwalia for the following 65 years.

To cut dead work, Hoover planned a radical change in the underground workings. A new underlie or incline shaft was to be sunk at 45° in the gold-bearing formation itself, involving relocating the mine entrance and installing completely new haulage machinery. Hoover in effect began the mine all over again. Haulage was to be done by a 50hp Risdon winding engine over a headframe of Oregon timbers 48' high which incorporated an automatic ore cart tipping device, primary crusher and ore bin. Work on the new incline shaft had commenced by September 1898, excavating upward from the existing workings, and the design of the ore treatment plans next exercised Hoover's engineering skills.

He was to find, however, that not all technical decisions lay in his control. The Coolgardie office of Bewick, Moreing was independently drawing up plans without in his view, consulting him adequately. Hoover wrote in June, "to disclaim any connection with any process or designs made at this juncture, for...I am not taking any responsibility for premature machinery." There followed further letters complaining that the headframe plans had been sent to London without his final advice, criticizing the layout of the proposed mill, and reflecting increasing friction between Hoover and his superiors. He left the Sons of Gwalia on 21 November 1898, for a posting in China, but was to return on a number of occasions as Bewick, Moreing partner responsible for mine management in later years.

Very little on the Sons of Gwalia mine site today dates from Hoover's term as General Manager. The headframe, winder and mill were not even commenced when he left. Probably the brick mine office and assay office were built, and the manager's residence was under construction. Nevertheless the plant that rose in the following year was Hoover's - excepting the modifications made to his displeasure in Coolgardie - and the methods of mining and milling which he devised were those which carried the mine through its prosperous first decade. Probably his most important legacy was the low cost of production he achieved. His final report as manager showed the cost per ton, even without the new plant, to be 24/4d, just 7% over the pound he had aimed at. Hoover claimed this was the lowest working cost of any Western Australian mine. In the context of Hoover's dictum, "The only true basis on which to judge the management of a mine is by working costs", this, as Hoover's biographer George Nash points out, was also a claim to the title of best mine manager in the colony.

Construction of the new plant took most of 1899. A thirty head stamp mill discharged over extra-long amalgamating plates onto Wilfley tables. The outflow was elevated by a 52 feet diameter raff wheel to the cyanide plant, and the tailings were heaped for re-treatment. Condensers were installed to distill mine water for domestic and boiler use; the Sons of Gwalia was fortunate in its supply of groundwater - the old shaft pumped 60,000 gallons a day - but the water was too salty for steam-raising. The mine produced nearly 40,000 ounces of gold in that year, with Hall's old mill still contributing. But completed in 1900, with the new mill expanded to 50 head, production soared to over 90,000 ounces. The directors paid 10% dividends in both years, and the Sons of Gwalia was firmly underway.

A community had grown around the reefs from the time of the first gold discoveries. In 1897 the Mount Margaret Goldfield was gazetted, with the warden's office situated at Malcolm. The warden had laid out a town site at Leonora the same year, in what at the time had seemed a position central to the new mining district, and within a year the town had three hotels, two banks, a telegraph office, a hospital, Mechanic's Institute, and enough private shops to anchor it permanently in position. However, most of the mines duffered out, or lingered on as small shows, while the Sons of Gwalia, 2½ miles south of the town, steadily grew to employ a workforce of 500 during it's construction boom of 1899. As the surveyed town site was inconveniently distant, the majority of the mine workers pitched their tents on the company's leases, and the community divided into defacto twin towns, Leonora and Gwalia, which survive to the present.

As Gwalia took more substantial form, with timber framed iron cottages appearing in the township or scattered on the leases, there arose a struggle between the two centres for the location of services. The town of Gwalia was surveyed in 1901, but lots were offered only on a leasehold basis, providing little incentive for the establishment of businesses there.

In order to attract custom to the commercial premises of Leonora, the Municipal Council established a steam tram service between the towns in 1903, and converted it to electric operation in 1908.



Figure 13 - Patroni's Guest House



Figure 14 - Mine Managers House

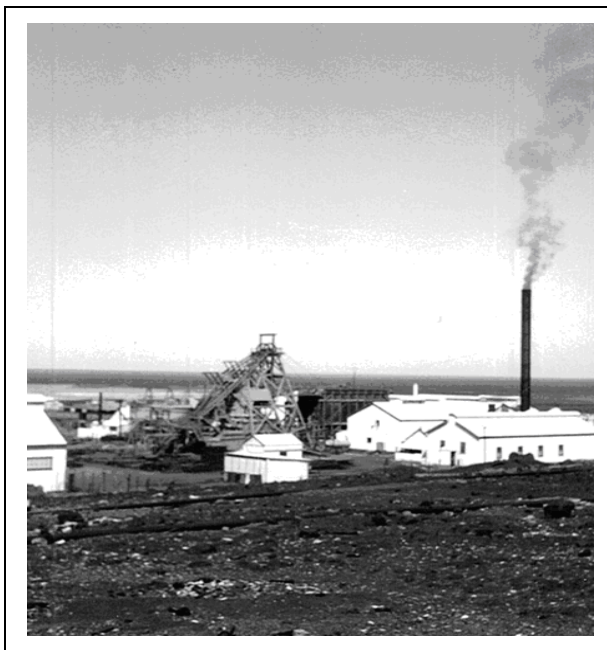


Figure 15 - Pre- 1935 View. Headframe in Centre

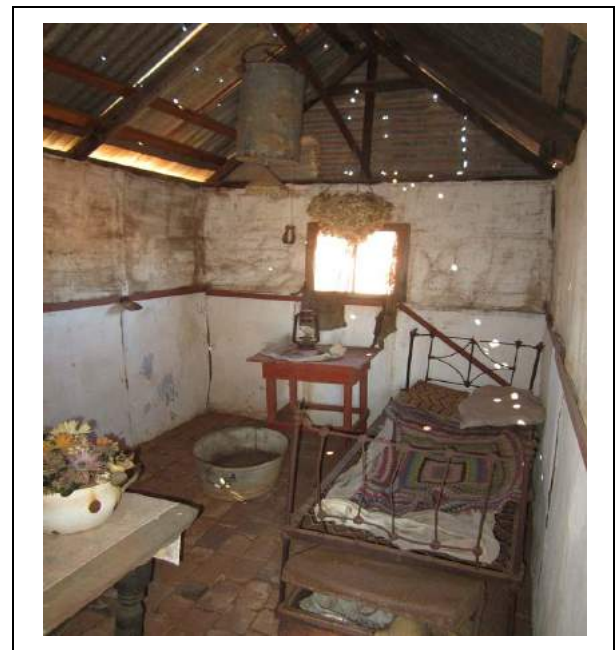


Figure 16 - Early Housing



Figure 17 - Early Housing



Figure 18 - Car - 1930s

But even this facility left a demand for separate services in Gwalia. In 1903 the Mines Department took the unusual initiative of combating the sly-grog trade opening Western Australia's first State Hotel there. Designed by Perth architect William E. Robertson, the two-storey brick hotel was by far the most imposing building of the town.

The company provided housing only for senior staff members. Although Hoover had constructed the company's main buildings in brick - "corrugated iron being out of the question in such a hot place as this" - the workforce fended for themselves in timber framed huts, clad with corrugated iron, lined with hessian and unpleasant in both the heat of summer and the cold of winter. Water had to be carried from the mine condensers. Many of the huts had no sanitary facilities, and no kitchens, for meals were available at several boarding houses for 30/- a week, a third of a rock driller's wage.

In 1898, George W. Hall had told the Sons of Gwalia Ltd shareholders: "we live under no alien flag, we have no alien labour in our mines", just six weeks before Herbert Hoover wrote to Pietro Ceruti requesting three good Italian miners". By the early twentieth century a large proportion of the underground miners were Italians or Slavs. A Royal Commission in 1903 found that 124 "foreigners" were employed in a workforce of 462, or 27%. Pressure to squeeze out non-British labour led in 1904 to a requirement that miners pass a language test, which led to a token reduction in the employment of "aliens" underground, while the company gave English language lessons where necessary. Single men among the Italian and Austrian miners tended to congregate in the makeshift encampment on the leases, while immigrant families lived in the town of Gwalia; Leonora was always the "British" town. In 1917 a Treasury accountant visiting the State Hotel observed: "The trade is practically confined to Italians. I hardly saw an Englishman on the premises, and during my stay I saw only one drunkard - and he an Englishman."

It is evident that both ethnic and social division existed to maintain the two distinct communities over many decades.

The Sons of Gwalia was in steady production from 1900 until 1910, yielding about 60,000 ounces of gold each year, and with payments to shareholders reaching 6/- per share in 1904 and 1905, the company had repaid dividends worth more than its entire issued capital by 1906. Material costs had been lowered by extension of the Menzies railway to Leonora in 1903, and total production costs were stable at just over a pound per ton.

Nevertheless there were emerging technical problems which would worsen with the passage of time. One lay in the power supply. The mine plant had been greatly expanded since its initial construction, by the addition of a large Cornish pump in the incline shaft in 1902, new Wilfley tables, filter presses and agitating vats in 1903, and concentrate roasters and a fine-grinding plant in 1904, a new compressor and Cassell filter in 1907.

All of this was steam-powered, and the mine had a massive bank of Cornish, Lancashire and Babcock & Wilcox boilers in the long boilerhouse west of the winder.

These in turn required an even more massive condensing plant to purify underground water for the boilers, as well as a light tramway network extending miles across the plains to supply mulga firewood for the boiler fireboxes, roasters and condensers. By 1910 the belief had emerged that steam was not the most efficient way to power such a demanding enterprise in such an inauspicious environment.

Further, underground development was proving awkward. Hoover had based the location of the incline shaft on the surface indications of the reef. But within a few years it had become apparent that the main orebody trended to the south. From 1904 onward the incline shaft had been sunk in dead ground, and each successive level was driven a greater distance to its right. Then in 1907, a new ore shoot was found even further south. The company relinquished its barren northern leases that year, and acquired leases held by small companies to the south. From 1908, diamond drills were installed on the lower levels to prospect ahead of the workings, as the location of the richest ores became increasingly problematical.

The scale of the underground workings was in itself becoming a problem. Dead work and wheeling distances cut into productivity as the orebody grew steadily more distant from the shaft. Ventilation in the lower workings was poor, and in 1907 the company undertook the expensive remedy of sinking a new vertical shaft to connect with the south shoot 1,175 feet below ground, both to assist the air current and to return tailings to backfill the stopes. But the most serious problem was the winding engine, which at 50hp was not up to the task of hauling men and ore from half a mile on the incline. Hoover had specified the engine's size in 1898 when the haul was a fifth of that distance; nevertheless, the engine remained in operation for thirteen years before it failed.

At the moment when the engine broke down in May 1911, it was hauling ten miners in a skip, which then ran away to the shaft bottom. Only three of those aboard were killed. The Chairman put the best face on this disaster by telling the shareholders that "the company was entirely exonerated from blame", but he could not conceal the fact that the Chief Inspector of Machinery had condemned the winding engine, nor that the company's entire extraction and treatment processes were in a state of crisis.

In 1910, the company had begun to investigate converting the plant to electrical operation, with power supplied by gas engines. A producer gas plant fired by charcoal was installed in 1911, with a gas engine coupled to an alternator.

Samples of mulga were sent to Britain for testing, and the results showed the boiler firewood could be far more efficiently utilised as gas producer fuel, without the need to convert it to charcoal.

The energy and water savings convinced the company, and in 1912 the first of a battery of wood gas producers was installed, together with a 660hp Kynoch gas engine. The gas engines operated alternators and compressors, and were eventually to power everything on the site except the incline shaft haulage.





The company's impressive gold yield and generous dividends disguised the fact that ore grade in the mine was steadily declining, and productivity had only been maintained by ever-greater tonnages extracted. Average grade fell from 22 dwt/ton in 1900 to 8 dwt in 1910. An analysis of the mill returns showed that relatively little of the gold responded to amalgamation, and three-quarters of total production was coming from the cyanide plant. Accordingly in 1914 the milling process went over to fine grinding and all ore was reduced to slimes for cyaniding. The Wilfley tables were abandoned, and all the stamp mill outflow was re-ground. For some years the mill had been increasing its battery of Forwood Down Wheeler-type grinding pans, but these were now largely superseded by three 18 foot tube mills. In 1912 the company bought out Sons of Gwalia South, and now commanded the entire orebody.

The most conspicuous development on the surface was the installation of the new steam winder. A two cylinder Fraser & Chalmers engine, rated at 1,000 hp and capable of hauling at 1,500 feet per minute was installed in 1913. The headframe was raised in height to 62 feet, with the old winder operating continuously while the new one was built behind it. Underground, horse traction was introduced to cut haulage costs along the drives.

From 1900 until the start of the First World War, the mine consistently produced more than 55,000 ounces of gold every year.

The net effect of these economies was to reduce production costs below even Hoover's most optimistic estimates. Cost per ton fell below a pound in 1912, with the gas plant in operation, and in 1914, with the new winder speeding extraction, it reached 17/5d. But the profits still fell. The last 1/- dividend was paid in 1911, and then the return was lower every year, to 1/- in 1917. Another of Hoover's legacies was lost in March 1918, when a new industrial award reduced the working week to 44 hours and raised the minimum wage. That year, for the first time since 1901, no dividend was paid.

With its incline shaft just short of 4,000 feet in length, the Sons of Gwalia was in 1919 the deepest mine in Western Australia, and yet probably the most economical in operation. Further reduction in mining costs seemed impossible; the underground operations must inevitably become bigger, slower and more expensive as the mine deepened. All indications were that ore grade would continue to decline, and labour costs to rise, thus any savings would have to be made on the surface. However the company had one asset that required no mining. Stockpiled by the cyanide plant were the tailings of twenty years of milling, representing the bulk of the 3,000,000 tons of ore that had been raised in that time, and still containing an unknown amount of gold.

The companies difficulties were echoed by a restlessness in the community.

A colourful incident erupted on 19 March 1919, when a meeting of fifty residents in the Australian Workers Union (AWU) hall voted for a Beer Strike: that is, a boycott of the State Hotel.

The strikers had a series of demands, covering the brand of beer offered, the price, size and cleanliness of glasses, and culminating in the demand that the hotel manager be dismissed or transferred. The Beer Strike persisted until the following September, although the intervening period was by no means a victory for temperance, as the prosecutions for sly-grog trading showed. During that time, the pneumonic influenza epidemic arrived in Gwalia, and the Health Department commandeered the empty hotel as a hospital during the emergency.

Two disasters beset the Sons of Gwalia in January 1921. On the first day of that month, the Burnside industrial award came into effect, raising the labour component of production costs by 30%. On the nineteenth, a fire broke out in the gas producer plant. It spread quickly and destroyed the gas engines, powerhouse, compressors and the entire secondary crushing and classifying sections of the mill. Dedicated effort by the company staff saved the headframe and winder to the north of the blaze, and the fine-grinding and cyanide plants to the south. The fire was ferocious; photographs of its aftermath show the blackened milling machinery leaning in disarray amidst a wasteland of ashes.

The accident was “unexplainable”, according to the Chairman of directors, and the insurers promptly paid the capital value of the plant lost, nearly ninety thousand pounds. Strangely, the efficient and profitable area of the plant - the slimes treatment works, producing three quarters of its gold output - survived, as did the entire haulage system, essential to the mine’s eventual recovery. All that was lost were the uneconomical parts of the plant: the secondary crushers, grinders and classifiers, and the gas engines, alternators and compressors which were in need of replacement by much bigger machines. The gas producers, while not unprofitable, provided the fuel for this selective fire.

The disaster allowed the company to dismiss almost its entire workforce, dramatically cutting expenditure for nearly three years. It also provided the opportunity to rebuild the most worrisome part of the treatment process at the underwriters’ expense. In the meantime, it spared the money-spinning section of the plant to operate throughout that period of rebuilding.

The effect on the Gwalia community was devastating. Practically the entire workforce - about 400 men - were dismissed. The Mines Department again came to the rescue, and provided sustenance payments of three pounds a week until the following June to men who had dependents living locally, provided that they also engaged in prospecting in the immediate area. Only 50 men were eligible, possibly some indication of the number of Sons of Gwalia employees living with their families, although many more must simply have left the district when the mine closed. The subsidized prospectors put 900 tons of surface ore through the Leonora State Battery during 1921, yielding a pathetic 146 oz.



Figure 20 – Miners by Headframe. Coming off Shift



Figure 21 – Gwalia Catholic Church



Figure 22 – Town Street. Swimming pool, just prior to opening in 1942

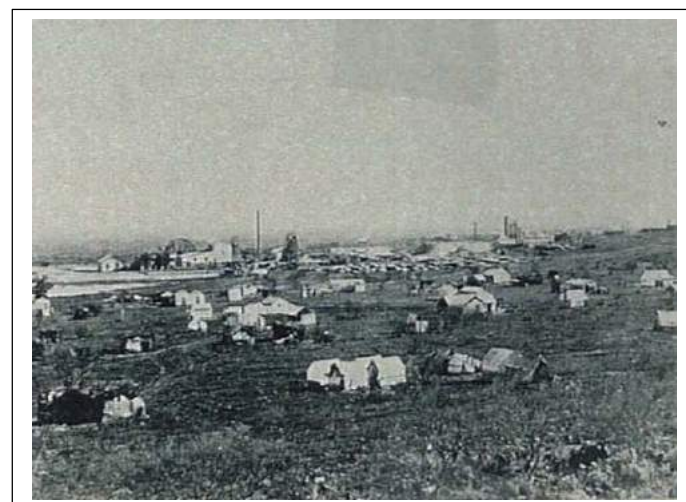


Figure 23 – Gwalia 1902

Recovery was accomplished in stages. The company reinstated a small gas plant and with a gas engine that survived the fire, had the fine-grinding plant running by October, treating 12,500 tons of tailings per month. For two years this provided the only source of income. Then in 1923 the mill was rebuilt with 30 stamps, the mine was pumped out, and production was restored. But this was by no means a return to the mines former heyday. The new workforce was only about 300 and annual gold production remained at about 30,000 oz during the 1920s. Further, the company's policy was cautious in the extreme. No money was spent on exploration or development; instead, all production came from the old stopes, which were progressively filled by tailings from the surface.

The community revived. The lack of private enterprise in the town of Gwalia had led in 1917 to the formation of a Co-operative Society which built a general store in 1919 beside the State Hotel. The Society was a genuine public initiative, funded by shareholders, with small subsidies from both the company and the union. Its profits were distributed as welfare payments within the local community. The Co-op barely survived the shut-down after 1921, but now in 1924 with the mine reopened, it expanded its activities. A butcher's shop, with its own piggery, abattoir and refrigerating plant, was opened to combat the meat monopoly of a local pastoralist. A picture theatre was established in the AWU hall, and Station Street became the focus of social and commercial activity in Gwalia during the 1920s.

It was not surprising that businessmen stayed away, for the mine appeared to have no future. The ore reserves were small and dwindling, and the cost of production has risen to over 27/- per ton by 1925. Each ton of ore raised in that year yielded an average 7 dwt of gold, worth 28/-. The company had no incentive to expand in the circumstances, and instead, began to talk of closing down. "Under the present heavy cost handicaps and severely depleted stopes the early cessation of operation is inevitable", the directors reported in 1926. Their audience was not the shareholders, but the State government, which had commenced negotiations with Sons of Gwalia Ltd over financial assistance.

In 1928 the State advanced the company 78,000 pounds, about half of which was to be spent on a new gas-powered compressor and drilling equipment, the remainder to finance underground development over three years. There was an inspection of the mine by Departmental engineers, who advised at length on the most fruitful areas for development in the orebodies, and investigated the ventilation problem. The air in 25 level was at 84°F, and the AWU had enforced the award clause on temperatures, requiring the mine to shorten shifts to six hours, further cutting productivity.

While the State report on the Sons of Gwalia's underground problems was being written in November 1928, Herbert Hoover was elected President of the United States.

State assistance to troubled mining operations has in many cases simply delayed the inevitable closure, and led to the waste of public money in a hopeless cause.

The Sons of Gwalia demonstrates that in some cases government intervention can provide the impetus to turn the situation around, or at least to hold it until other circumstances operate to bring recovery. Vigorous development recommenced in the mine in 1929. Diamond drilling was resumed, and the incline shaft was sunk below 4,000 feet after having remained static since 1920.



For the first time in a decade, the stopes began to penetrate new areas. In 1930, production rose to nearly 40,000 oz, and the company made a meagre profit, the first since the fire. Then in 1931 came the miracle: the gold price rise.

It is an economic paradox that the gold industry prospers in times of depression. The price of gold, fixed for centuries, rose from just over four pounds per ounce in 1931, and continued to rise in steady increments, reaching nearly sixteen pounds in 1949. Simultaneously, the Australian pound fell in value relative to the pound Sterling, which was good news for English companies working Australian mines. And the Australian government contributed even further to the industry's revival by paying a bounty on increased gold production. The Sons of Gwalia's decade of misery was over. The company repaid the government loan in full in 1932 - ten years before it was due - and had enough profit left over to pay a 2/- dividend. In the following decade the shareholders received over six hundred thousand pounds from the mine that was doomed to close.

The nature of the mine's operations altered significantly during the 1930s. The diamond drills disclosed deep extensions to the oreshoots, and the main incline shaft was sunk progressively deeper, bottoming at 5,036 feet in 1939. The deep ore had a consistent grade of about 6 dwt to the ton, but it was changing in character. In 1929, two-thirds of the ore extracted had been oxidised, but as extraction went deeper, more sulphide ore was produced; 85% by 1935. The sulphides were harder to mine and more complex to treat, and required completely new tube mills and classifiers on the surface.

Underground, huge blowers were installed on 26 and 27 levels to ventilate the deep workings. In 1932 the last of the surface tailings had been re-treated and sent underground, and now backfilling was done with mullock sent down by chutes from an open-cut gloryhole south of the headframe.

The haulage system was once again looming large amongst the mine's technical problems. The struggle to maintain production from the deep levels kept the twenty-year-old engine racing non-stop, hauling ore from nearly a mile deep. Each load weighed thirteen tons at the moment it left the bottom level - three tons of ore-cart, four tons of ore, and six tons of cable - and a load was up-ended into the surface ore bin every 3 minutes. A rock falling onto the rails or a winder driver dozing off could mean an expensive accident. There were twelve serious derailments or overwinds between 1932 and 1936; the worst incident was in March 1935 when an ascending ore-cart left the rails, tearing out a thousand feet of shaft timbering and wrecking four underground ore bins in the forty seconds before the driver stopped it.

The mine was closed for a month. Two months after it was back in service, the engine crankshaft broke, and another fortnight was lost. Heavier rails were laid, and bigger skips and a slower haulage rate adopted to ease the problems. Sheer scale was beginning to tell against the company's operations; by 1935 the mulga cutters at the end of the firewood tramway were camped fifty miles from the mine.

The years of prosperity were put to good use, with major re-investment in bigger and more efficient surface plant. In 1938-39 the surface buildings were supplemented by new workshops, a foundry, staff housing, three additional gas producers, scrubbers and cooling towers, and the entire gas-powered alternator and compressor plant was duplicated to eliminate down-time during maintenance. A swimming pool was constructed on Tower Street overlooking the mine, to provide both a welcome community facility and good head of water for fire fighting.

These investments were timely, for they were to carry the company through the lean years that lay ahead. The war brought labour shortage, exacerbated by the internment in 1940 of the Italian nationals amongst the workforce. Production fell sharply. Labour was also diverted to development in the lower levels. A review of the mine's operation 1937 had put the winder's maximum haul at 5,000 feet, but the diamond drills proved ore reserves far below it. Accordingly new arrangements were made to exploit the deep orebodies. At 30 level, 3,251 feet below the surface, an internal vertical shaft was sunk from 1939 onward, and 31 and 32 levels were developed for stoping. The internal shaft was fitted with its own electric winder, and eventually reached 527 feet in depth in 1948, making the mine's total vertical distance 3,778 feet.

The end of the war had not eased the labour shortage. In an attempt to replace the Italians, few of whom had returned to Gwalia from the internment camps, the company shipped 67 miners directly from Italy in 1941, but only 31 of them were still at the mine a year later, and recruitment of labour became a standing concern. That labour was becoming more expensive. In 1948 the national working week was reduced to 40 hours, and wages rose. Average ore grade was down to 5.6 dwt per ton, and dropping each year. In that year the company made a loss for the first time since 1929. There was a small recovery in the following two years, but the dividend of 1950 was the last the shareholders were to receive.

The Sons of Gwalia was in its final decline, but was to prove tenacious. The remaining years were a battle to survive the opposing forces of rising production costs and falling ore values, which when they met would squeeze the mine into extinction. The company found itself in the situation of on one hand mechanizing its operations to reduce labour costs, while still struggling to attract necessary labour to the mine.

Mechanical scrapers and loaders appeared on the stopes, replacing men wielding shovels.

In 1955 the underground horses were retired, and replaced by electric locomotives on 28 and 30 levels. On the surface the mill flow was simplified, with a Symons crusher feeding by conveyors directly to the tube mills, by-passing the gravity stamps. The old cyanide plant was completely rebuilt with larger thickeners and agitators, and Oliver filters replaced the old Cassell unit. This last grand economy effort actually held production costs stable for a few years, but the company was no longer buying plant out of its profits. The State had stepped in again with a loan of 100,000 pounds in 1953 to keep the mine open. And it was a sign of the times that the cyanide plant and underground locomotives were not new, but were bought second-hand from gold mines that were closing down at Wiluna and Big Bell.

After half a century of indifference to living conditions in Gwalia, the company finally awoke to the fact that it could not keep its workforce because the town was, for many of them, a thoroughly unpleasant place to live. With the rise in living standards of the 1950s, miners were not prepared to raise families in the earth-floored iron huts that had been thrown up in Hoover's era.

A State loan was used in 1955 to build a kitchen and dining hall accommodating 100, and rooms and a central bathroom for 42 single men. The company's need to institutionalise living facilities reflected the slow death of the town of Gwalia. The Co-op closed down in 1957, leaving Mazza's store as the town's one shop. The pictures closed the following year, and the State Hotel was sold to a syndicate of local residents in 1960.

In 1955, Sons of Gwalia Ltd had moved its head office from London to Perth, and re-organised under a local board of directors. The State advances steadily increased in size, and there was little prospect of repayment, as the mine barely paid its production costs each year. In 1958 the Sons of Gwalia yielded over 30,000 oz of gold, and made a profit of 41 pounds. The deep levels had proved an expensive failure, and most ore in the last years came from the stopes above 30 level, wherever the diamond drills revealed payable grades. By 1963 the company owed the state 366,000 pounds, and was running at a loss every year. On 6 December that year the directors met to consider the latest geological reports, and learned that the ore in sight averaged below 3 dwt to the ton. 4 dwt was the economic threshold. There was no option but to close the mine.

On Friday the thirteenth the announcement was made that the mine would close on New Year's Eve. An accident intervened on 27 December when another ore-cart was overwound, damaging the headframe, and putting the south shaft compartment out of action. Ore haulage ceased immediately, and the mine was finished. The population of Leonora and Gwalia was about 1,700, of whom at least two-thirds were financially dependent on the mine. Its closure caused dislocation, but little distress, for the workforce of 250 were rapidly absorbed by the mines of Kalgoorlie-Boulder, some of whom advertised in the press for experienced Gwalia miners. The exodus began immediately, encouraged by concession railway fares and housing subsidies. On 17 January 1964, the Gwalia Hotel closed its doors on a town that was nearly deserted.

Sons of Gwalia went into receivership within days of the closure. The major plant items on the mine site were bought by the State, and smaller plant and stores were sold at auction in October 1965. The site was progressively stripped of useful machinery and the remaining buildings fell into disrepair. For many years Western Mining Corporation used the mine offices and the hotel as their base for mineral exploration in the district. The town of Gwalia was never entirely abandoned, and still has a small population.

Sons of Gwalia Limited chairman, J.A. Ellis, at the company's annual general meeting of 13 December 1963, stated in part:

While regretting the necessity for the mine to close down, your Directors would point out that in its 65 years of existence it has been a very important factor in the economy of Western Australia. It has produced over 2,570,000 ounces of gold from nearly 8 million tons of ore mined; has made net profits of nearly £4½ million; has paid dividends amounting to nearly £2½ million (equivalent to eleven times its original capital) and paid over £1 million in Income Tax. It has also provided continuous employment over its long life to many hundreds of employees. It has now been caught between the upper and nether millstones of a fixed gold price, and diminution of values, respectively.

In the memorandum to shareholders covering the year ended 30 June 1964, the chairman stated in part:

The contributing factors which led to the decision to cease mining were continued low grade and unpayable developments in the West Lode. The low grade and poor developments made it impossible to carry on without incurring heavy losses. As there was no immediate prospect of any higher grade ore being found, mining under these conditions was not justified. On January 1, 1964 the Minister for Mines in the Government of Western Australia appointed a Receiver and Manager of the whole of the company's assets and undertaking pursuant to the conditions of a debenture given by the company to secure the Government's advances. At June 30, 1964 the company's accounts showed an estimated deficiency of £A282,457, after providing the sum of £A293,946 for estimated loss on ultimate realisation of assets. Because of this deficiency it is clear that the company's debt to the Government cannot be satisfied in full and it is equally clear that the company's shares now have no value. On August 13, 1964 the Directors arranged for a public statement to be made to this effect, which was published in leading newspapers in Australia and England.

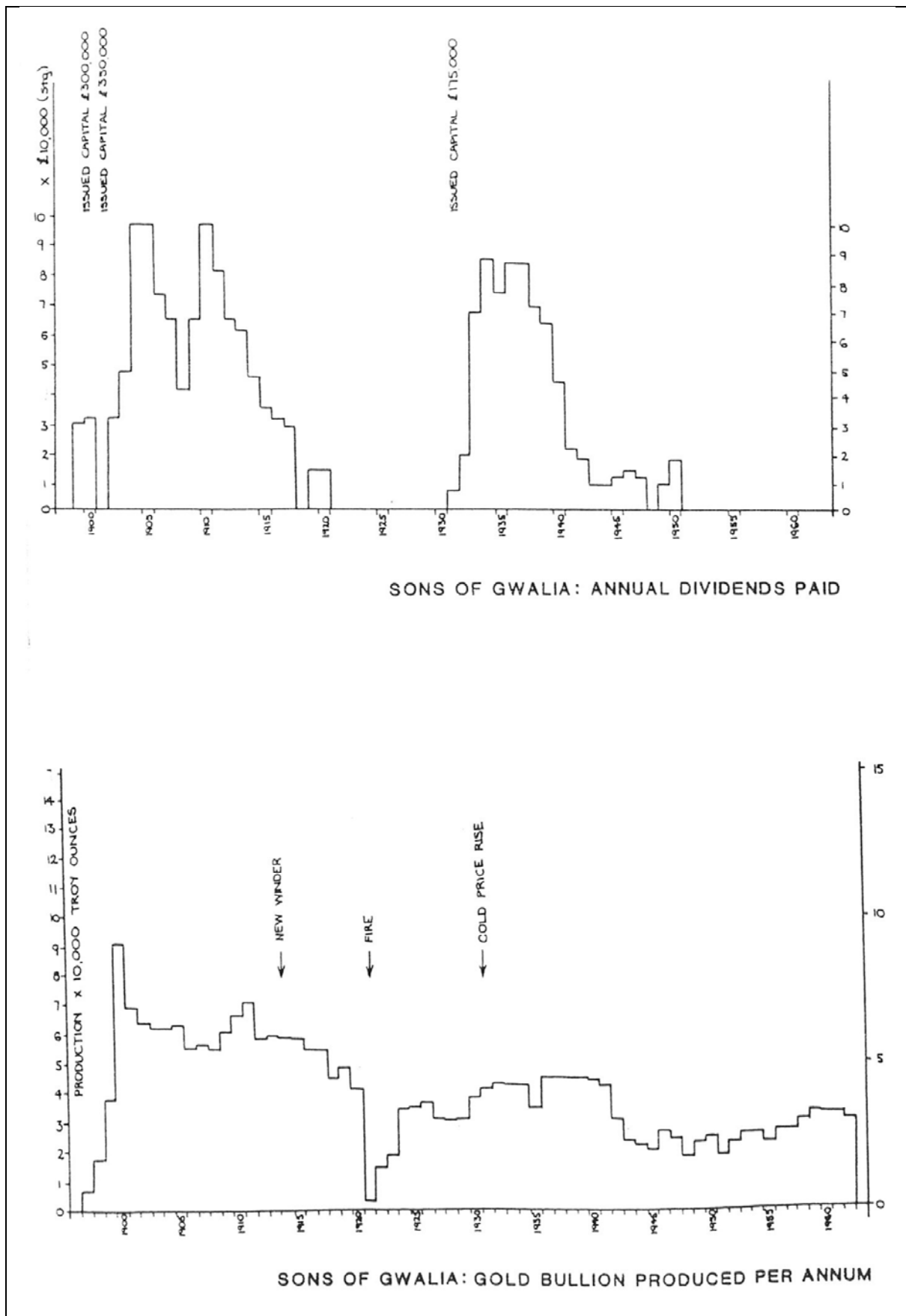


Figure 24 – Statistics 1896 – 1963



## 6.2 Gwalia Museum Group

In 1970, an exploration geologist Don Reid and his wife Donna came to live in the mine manager's house. Together with another geologist, David Quick and his wife Linda, they established a museum in the former mine office. The Reids had begun collecting soon after their arrival and the museum was opened in May 1972. It comprised six rooms and the verandah of the former mine office 'recording the history, activities, ingenuity, working and social lives of the residents of Gwalia and Leonora'.

In 1971 the Leonora Tourist committee was formed by the Shire council. At this stage the Gwalia houses were being bulldozed in an attempt to clean up the area. Over time, the significance of Gwalia was appreciated more and one of the Tourist Committee's aims came to be to preserve the town of Gwalia to represent the goldmining era. Museum volunteers were active in this organisation and it had a focus on museum activities.

During the 1970s the museum had to become incorporated to start applying for grants and so the Gwalia Museum Historical Association was established. It had members from the Leonora Shire Council, Western Mining Corporation, Sons of Gwalia and the Goldfields Tourism Association.

When the price of gold rose in 1980, a new company, Sons of Gwalia NL was established and later it began open cut operations. This destroyed much of the original mine buildings and housing and changed the context for the museum. The explosions for the open cut also damaged the remaining buildings in the museum precinct.

As a result of damage to the mine office, all the artefacts were moved out and placed in storage for a couple of years while the building was renovated. In 1987 the headframe and steam winder were moved from the pit to their new positions, rebuilt in correct relation to each other, and the museum was closed as there was no safe access to the buildings while the relocation was being undertaken.

The headframe had been purchased by local pastoralist Jack Bell when the mine's buildings and assets were auctioned in 1965. Action from the museum's curators ensured that it was fenced instead. It was threatened again in the 1980s when the open pit expanded and was rebuilt in correct proximity to steam winder in 1987. It was later donated to the museum. The steam winder was saved when it initially proved too heavy to remove after it was sold for scrap in 1965. The delay enabled the Goldfields Esperance Development Committee to lobby and ensure its preservation.

In 1986-87 the assay office was substantially demolished and rebuilt as before, and artefacts relating to assaying were returned to the building. The assay office now houses most of the archive and photograph collections, displays on assaying, and office and meeting facilities.

In 1989 the Gwalia Museum Group was formally reopened.

The Museum collection has a wide scope that reflects much of the history of the district as well as the groups that have been involved in the museum's operation over more than thirty years. The collection represents mining, particularly the Sons of Gwalia mine, life in the towns of Gwalia and Leonora and pastoralism in the Shire.

There are many artefacts from the mine at the Museum. The largest and most well-known are the headframe and steam winder. The headframe still has the tipping ramp, ore bin and primary crusher. Next to the headframe are skips for transporting people, firewood, horses and ore in and out of the mine. Within the document collection are the drawings for building the headframe from about 1898.

There are many artefacts in the museum that are associated with the buildings and other key features of the site, including Hoover House, the mine office, the assay office, the houses and commercial buildings in Gwalia, the woodline railway, and the mine and mine infrastructure.

Research has indicated these are the most significant items in the collection.

There are many other Sons of Gwalia mine artefacts at the Museum. These include the mine model, pot for carrying liquid samples to the assay office and wooden patterns.

Hoover House was restored after the tornado removed part of the roof and most of the verandah. The restoration was funded by the Department of Transport and Regional Services Regional Assistance Program, the Goldfields Esperance Development Corporation and the Sons of Gwalia Mining Company. Hoover House was opened as a Bed and Breakfast by the American Consul General Mr Oscar De Soto in March 2004.

Many of the original elements of the assay office are displayed within the building. These include the kilns, gold balance, crucible stands, cupels, and gold bar moulds. Original benches are also visible. A large, redwood pine table on the verandah of Hoover House during Tim Hewson's time as manager was formerly in the assay office. Large crucibles are displayed on the verandah of the mine office.

The current collection policy states that the museum's intent is to:

collect articles, items, objects or material relevant to the history of the Sons of Gwalia Gold Mine, mining in general, the settlements and people of the area incorporating the Shire of Leonora from 1869 to the present.

In 1995-96 twenty-seven of the houses in Gwalia were rebuilt. When the mine had expanded into an open pit in the 1980s, the houses that were in the way were removed and put into bundles. The mining company rebuilt a couple of them and some other people started rebuilding but they were never finished.

In 2001 the owners of Sons of Gwalia, Chris and Peter Lalor, set up a public company, the Leonora Gwalia Historical Museum. It is a shelf company for the museum which enables it to own land, property and sign leases. As a company the museum was also able to obtain charitable tax status. The Company replaced the Gwalia Museum Historical Association and the Leonora Tourist Committee and has Council representative and Chris Lalor on the board. The company owns the buildings and has the lease for the land inside the museum boundary fence.

In February 2002, Lot 1128 was gazetted as part Reserve 46751, which is an historic precinct vested in the Leonora Gwalia historical Museum Inc.

## 7.0 BASIC DATA

- 7.1 Item Name:** Sons of Gwalia Headframe and Winder Engine
- Location:** 28° 50' S, 121° 30' E
- Address:** Lot 1128 Tower Street Gwalia, 4 km South of Leonora
- Suburb/Nearest Town:** Leonora
- State:** Western Australia
- Local Govt Area:** Shire of Leonora
- Owner at time of Mine Operation:** Sons of Gwalia Ltd
- Current Use:** Tourist museum
- Former Use:** Pastoral and Mining
- Designer:** Sons of Gwalia Ltd
- Builder/Maker:** Headframe - Sons of Gwalia Ltd  
Winder Engine - Fraser and Chalmers, UK
- Year Started:** 1898
- Modifications and Dates:** Numerous - 1898 to 1963. Refer to Historical Summary
- Historical Notes:** refer to Historical Summary.
- Heritage Listings:**
- State Heritage Office of WA - Place number 01465

- |                                    |                             |            |
|------------------------------------|-----------------------------|------------|
| • Register of Heritage Places:     | Interim Entry               | 23/09/2005 |
|                                    | Permanent Entry             | 07/09/2006 |
| • National Trust Classification:   | Classified                  | 23/03/1978 |
| • Town Planning Scheme:            |                             | -----      |
| • Municipal Inventory:             | Adopted                     | 17/02/1998 |
| • Register of the National Estate: | Headframe and Winder Engine | 21/03/1978 |

## **8.0 PHYSICAL DESCRIPTION AND CURRENT CONDITION**

Underground mines such as Sons of Gwalia consist of the following essential components:

- A shaft sunk in the ground
- A skip to bring ore to the surface
- A winding engine to haul the skip to the surface
- A headframe to lift the skip above ground level, where ore is emptied into a bin
- Plant to crush and treat the ore

This nomination relates only to the headframe and winder engine.

### **8.1 Headframe**

The purpose of the headframe was to guide the hauling ropes between the Winder and the skips in the shaft and enable the skips to be elevated so the ore could be discharged at a convenient height above ground. The original Headframe was about 62 feet (19 metres) high with a 45-degree runway on the same incline as the mineshaft. The skips were emptied into a storage bin within the Headframe structure. The primary crusher was located beside the Headframe and the ore from the storage bin was fed into the primary crusher by gravity. In the crusher, the ore was reduced to a (probable) minus 25mm size. From there, a belt elevator carried the ore up to the main storage bin where it was held for further processing.

The design of the Sons of Gwalia headframe has been attributed to Hoover but as he complained that he hadn't been able to check the design before it was sent to London, it may have been designed by Bewick Moreing's Coolgardie office. They certainly had men there who had the capability.

The headframe was built of oregon, imported from America. At the time Oregon was cost effective and was used widely for building and mine construction in Western Australia. Being relatively light weight (about half the density of locally available jarrah and karri hardwoods) it also had the advantage of being easier to transport and erect.

The main structure of the headframe still existing originates from the initial construction in 1896-8 which was later substantially extended in 1912 with the installation of the new steam winder.

The ore bin also appears to be basically in its original construction dating from 1896-8 with a number of minor alternations to the draw-points from the bin.

The internal sections of the headframe associated with the tipping of skips, the separation of fines and coarse ore, chutes and primary crushing facilities, have been modified several times during the operation of the mine to suit the changing mining techniques, crushing and treatment plant facilities.

Sons of Gwalia Headframe and Winder Engine – Nomination - Version 3 – 29 January 2016



The structure consists of three components:

- The ore bin which had its own foundations elevated above the surrounding ground was designed to handle the substantial loads from the uncrushed ore tipped from the skips.
- The inclined ramp which is basically self supporting and which relied on the main tower for lateral support under skip tipping loads.
- The main tower structure supporting the head sheaves which had its own foundations and was designed to resist the forces exerted by the main winding engine and associated equipment, skip tipping, chutes and crushing plant.

Following closure of the underground mine in 1963, the headframe was going to be demolished in the 1970s when it was assessed by the Mines Department as unsafe. Action from the museum's curators ensured that it was fenced instead. It was threatened again in the 1980s when the open pit expanded. It was rebuilt in correct proximity to steam winder in 1987. It still has the tipping ramp, ore bin and primary crusher. Next to the headframe are skips for transporting people, firewood, horses and ore in and out of the mine.

The headframe timbers are in a very deteriorated state, due to de-fibreing, splitting and exposure to the elements. Steel bolted assemblies have severely corroded and rust is widespread. Recently consultants Intelara reported on the structure and recommended widespread strengthening and stabilisation. It is understood these recommendations are soon to be implemented.

The headframe can be viewed by visitors to the museum, but is fenced off to prevent access up close.

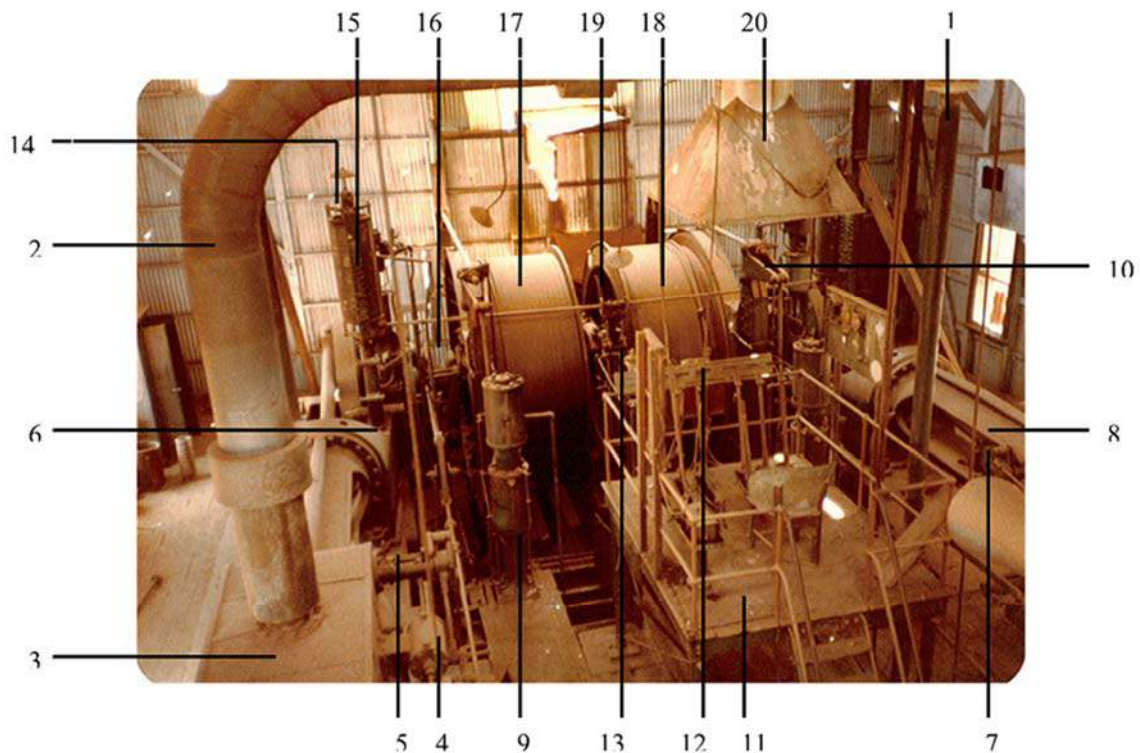
## **8.2 Winder Engine**

The original winder engine installed in 1898 was a 50 horsepower machine supplied by Risdon Iron Works, UK. It operated with a two ton skip, and hauled 300 tons of ore in a 24 hour period.

By 1912 the shaft was down to 2,800 feet on the incline (1,900 feet vertical), the deepest in WA, and the winder machine was inadequate. A new engine was ordered by Fraser & Chalmers of Erith, Kent, England, who built a wide range of mining machinery from around the turn of the century including many large winders. The company is now incorporated in the General Electric Co.

In 1912 the Western Australian Department of Mines declared the Risdon engine as unsatisfactory for use on the mine and issued a limited permit for its use pending installation of a new engine.

The Annual Report of the Department for 1912 reported on the situation in these terms.



#### ENGINE PARTS IDENTIFICATION

<u>Reference No.</u>	<u>Name</u>
1	Main Steam Stop Valve
2	Steam pipe to left H. cylinder
3	L.H. Steam Chest
4	Corliss Valve Wrist Plate L.H.
5	Corliss Steam Valve Shaft
6	Gooch's Link Motion L.H.
7	Gudgeon Pin and Crosshead R.H.
8	Crosshead Guide R.H.
9	Power Brake Cylinder R. & L.H.
10	Post Brake R.H.
11	Drivers Platform
12	Drivers Control Levers
13	Power Reversing Cylinder, Common
14	Skip Level Indicator L.H.
15	Declutch Power Cylinder L.H.
16	Main Shaft
17	L.H. Drum
18	R.H. Drum
19	Speed Governor
20	Ventilation Canopy

Figure 26 – Winder Engine Parts

A new winding engine of thoroughly modern construction is at present being installed at the Sons of Gwalia Gold Mine, to replace an engine that was undoubtedly unequal to the increased work latterly imposed upon it, and was consequently condemned by this Department except for use under restricted conditions, and that only for a limited time. At the time of writing this report the new engine is almost completed, and will probably be ready for the official test about the middle of April.

The new engine is by Fraser and Chalmers, Ltd., and is a direct-acting, double-drum engine. The cylinders are 27in. Diameter with 60in. stroke, and diameter of drums is 10ft. It is fitted with Corliss valve gear and governor. The post brakes, friction clutches and reversing gear are all operated by steam, and the disc brakes are operated by foot levers. Both drums are loose on shaft, and are operated by friction clutches.

The cut-off gear has a range from zero to 7/8 of the stroke, and is operated by the Seymour patent late tripping arrangement, which has the advantage of securing an equal cut-off at each end of the stroke at all points of cut-off.

There are two sets of post brakes operated by weighted steam brake engines of Fraser and Chalmers design, which includes the Whitmore patent self-adjusting variable load appliance, thus enabling the driver to apply any desired load to the brakes, ranging from zero to the full load. The brakes are applied by the weights and released by steam. This arrangement, of course, enables a driver to apply the brakes in case of steam failure through a burst pipe or other cause.

The disc brakes are connected by means of a substantial wayshaft and levers to foot levers on the platform. The depth indicators consist of cylinders spirally grooved, and fitted with necessary pointers. The cylinders are driven by cut gearing from each drum, and will indicate a total depth of 5,000 feet.

The following specification for the winder engine was prepared by the authors of the Conservation Plan prepared in 1985.

Purpose	Winding from inclined shaft.
Manufacturer	Fraser and Chalmers or Erith, Kent, England
Date of Manufacture	1912-13
Type	Twin cylinder simple expansion
Cylinders	Number - 2 Diameter - 27 inches Stroke - 5 feet
Valves	Corliss type
Reversing Gear	Link Motion – Gooch's
Brakes	Power Operation – Fraser and Chalmers Steam/Oil Post brake on each winding drum with power operation by Fraser and Chalmers brake engine.
Winding Drums	Number - 2

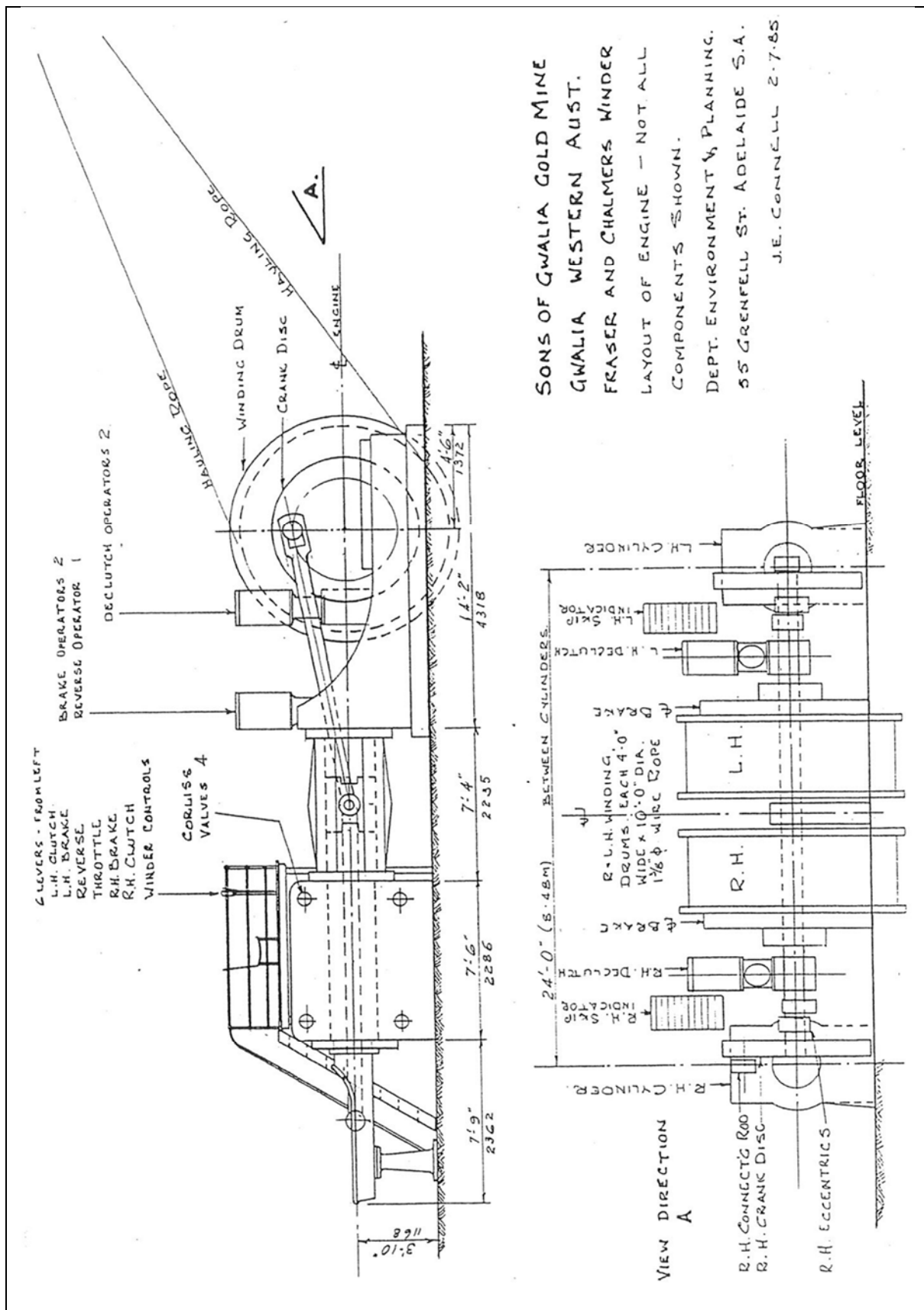


Figure 27 – Winder Engine Details

Drive	- Clutched on Crank Shaft
	Diameter - 10 feet
	Width - 4 feet
	Clutches - One within each drum
	Operation - Fraser and Chalmers Brake Engine
Steam Pressure	Probably 120 pounds per square inch
Horsepower	Probably rated 1,000 H.P.

Figure 26 is a sketch layout of the engine to show the main components. It is described as not complete in all details.

The speed of the Engine appears to have been about 1,500 feet per minute, or approximately 48 revolutions per minute of the winding drum. The speed was frequently under review at Sons of Gwalia due to trouble with derailment and other faults. Various alarms and safety devices were added in 1937 to prevent overwinding or slipping of the skips. The Gwalia Winding Engine is claimed to have represented a "a generation of engines when all features had reached the acme of superior design". Steam winders continued to be manufactured, in diminishing numbers, until about 1943, when electric motors and satisfactory switch mechanisms were developed.

The winder engine is now situated alongside the headframe in a purpose built fully enclosed shed, open to visitors of the museum. It is in good condition but unlikely to have been in operation since closure of the mine in 1963.

Apart from the Sons of Gwalia one, there are now no other Fraser & Chalmers winding engines in WA. There is only one other steam winder in the state which is the Great Boulder Perseverance No 6 shaft winder (usually called the Perseverance No.6 shaft winder) which was built by Thompson & Co of Castlemaine and installed in Boulder in 1910.

When the Sons of Gwalia winder was erected in 1913 there were 15 other large winder engines operating in WA. Except for two of these and perhaps two others, all 11 others had smaller capacities than the Sons of Gwalia engine. All 14 large non-compound condensing engines were surprisingly similar in operation although built by 9 different companies.





Figure 28 – Winder Engine (2013)



Figure 29 – Winder Engine (2013)

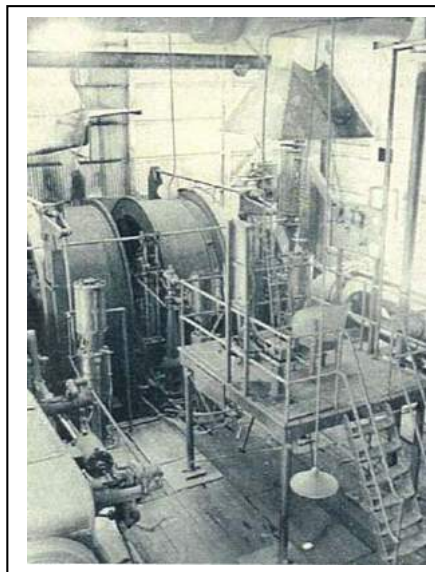


Figure 30 – Winder Engine (1963)



Figure 31 – Winder Engine (2013)

## **9.0 ASSESSMENT OF SIGNIFICANCE**

### **9.1 Historical Value**

- The headframe and winder engine were an integral part of the Sons of Gwalia mine, one of the major underground gold mines in Australia, and one of the most productive Western Australian gold mines outside Kalgoorlie, which operated from 1896 to 1963.
- The headframe had a short, but significant, association with Herbert Hoover, later President of the United States of America, and who was manager of the mine in 1898.
- The headframe and winder engine were part of the Sons of Gwalia mine, which was operated by Bewick, Moreing, a major engineering consultant and mine manager operating worldwide.
- The headframe and winder engine can provide information about the technology and methods of the mining industry in the period 1896-1963.

### **9.2 Aesthetic Value**

- The headframe has a landmark quality demonstrated by its visual impact around the towns of Gwalia and Leonora, both by day and by night when it is flood lit.

### **9.3 Scientific and Technological Value**

- The Sons of Gwalia mine, of which the headframe and winder engine formed part, operated for 65 years, the longest period of continuous operation of any mine in the State outside of Kalgoorlie-Boulder.

#### **The headframe:**

- Is a fine example of a large timber structure, complex in geometry, innovative in design and constructed at low cost.

#### **The winder engine:**

- Is claimed to have represented “a generation of engines when all features had reached the acme of superior design,”
- Is a fine example of a large steam-powered machine which operated from 1913-1963 and is an example of technological achievement in 1912.
- Was part of the Sons of Gwalia mine, one of Australia’s major underground mines in terms of operation time, output and scale.
- Operated skips from an incline shaft, just short of 4,000 feet in length in 1919, the deepest mine in Western Australia and at it’s peak production was one of the most economical.

## **9.4 Social Value**

The Gwalia Museum Group, of which the headframe and winder engine constitute the major part:

- Is valued by the local and wider communities for its associations with the early gold mining history of the towns of Leonora and Gwalia and the ongoing value of the place as a frequently visited tourist attraction in the area, evidenced by the efforts of the local community in restoration, preservation and presentation of the group and the development of the Mine Office as a museum.
- Contributes to a sense of place for the local community and visitors, as a significant remnant of the early mining history of the region and the landmark quality of the Headframe.
- Contains items which represent a past lifestyle to former residents and their descendants, many who came from overseas, including Italy and Yugoslavia, who return to see where and how family members lived and worked.

### **The headframe:**

- Is significant for community efforts to save it in 1965 when the mine's assets were auctioned, in the 1970s when it was assessed as unsafe and again in the 1980s when the open pit expanded and it was relocated to its current position.

### **The winder engine:**

- Is significant for the community effort to save it in 1965 after it had been sold for scrap, in the 1980s when the open pit expanded and it was relocated to its current position and in 2000 when the steam winder shed was blown down by the hurricane and rebuilt.

## 9.5 Degree of Significance

### 9.5.1 Rarity

#### The Headframe

Timber headframes are now very rare in Australia. During the last 30 years a great number have been lost. Primarily due to timber degradation and corrosion of connecting plates and bolts. In 2005 there were only 5 known to be still in existence. Two at Broken Hill were on their original sites (South Broken Hill No. 7 and North Broken Hill Consolidated No. 3) and were apparently still used for service and maintenance. Mining operations at Broken Hill are still subject to changes. The other three headframes are in WA – the Sons of Gwalia headframe at Gwalia, Hamilton headframe and the Monty headframe in the APM Hall of Fame. These three have been removed from their original sites due to open cut operations and have been re-erected. The two at APM Hall of Fame are owned by the WA Museum.

The Sons of Gwalia headframe is the oldest of the three in WA. The Hamilton headframe was built in 1902 and had another two metres added to it in the 1920s. The Monty headframe of South Kalgurli was built in the mid 1910s. Mount Morgan Mining Company built a very large timber headframe over a 45 degree inclined shaft in 1905. This structure is shown in figure 32.

The Gwalia headframe is the only large timber underlie, or incline, headframe surviving in Australia, and one of very few timber headframes of any size from the nineteenth century still in existence world-wide.

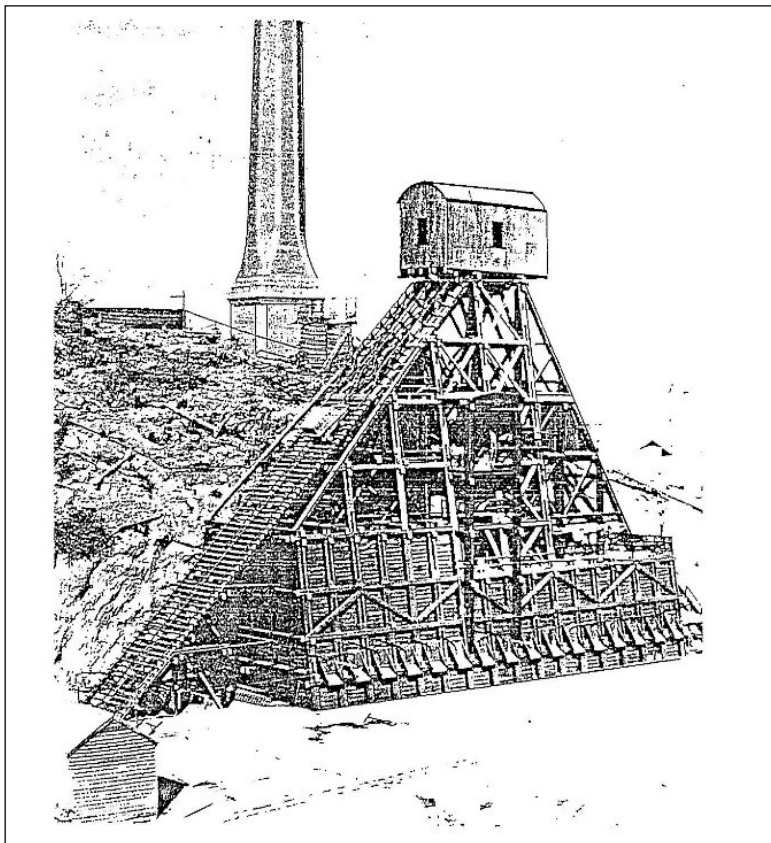


Figure 32. Massive headgear and storage bins of the new inclined shaft at Mount Morgan, Queensland

## The Winder Engine

The Sons of Gwalia winder engine is one of three located on the Register of the National Estate, the other being at the Yerrandie Silver Mining Field, Oakdale NSW, where there are two smaller steam winding engines as part of the larger mining complex.

In Western Australia there is only one other double drum steam powered winder engine. This is located in the grounds of the APM Hall of fame in Kalgoorlie, and is housed in the former Hainault Winder Room. It was made in 1910 by Thompson and Co of Castlemaine Victoria for the No. 6 shaft of the Great Boulder Perseverance Mine at Boulder. It is believed this was not as powerful as the Sons of Gwalia engine.

Other large steam winder engines still in existence in Australia include:

- Richmond Vale winding engine, manufactured by Fraser and Chalmers in 1907. Until 1986 this winder worked at Sutton Manor Colliery, St Helens Lancashire, which dates from 1888. In 1988 it was exported to Richmond Vale Colliery, near Newcastle NSW. In 2010 the winder was discovered dismantled hidden away in a lean-to shed. Refer to figure 33. This horizontal cross compound winder had Corliss cylinders of five foot stroke (1525 mm) and worked at 150 psi (1 MPa) steam pressure.
- The winder at Gympie Gold Museum, smaller in size than the Gwalia engine.
- A winder originally from Hebburn Colliery near Newcastle, also smaller in size than the Gwalia engine.



Figure 33. Fraser and Chalmers winder at Richmond Vale Colliery

### **9.5.2 Representativeness**

- Both the headframe and winder engine are representative examples of infrastructure associated with mining from the late nineteenth to mid-twentieth centuries, and as such contribute to a greater understanding of the mining operations in the area from 1896 to 1963.

### **9.5.3 Integrity**

- Although the headframe and winder engine no longer perform their original function, both have retained a moderate to high degree of integrity.

### **9.5.4 Authenticity**

- Both the headframe and winder engine demonstrate a moderate to high degree of authenticity





Figure 34 – Top of Headframe (2013)



Figure 35 – Base of Headframe (2013)



Figure 36 – Headframe – Deteriorated timber (2013)



Figure 37 – Headframe – Deteriorated timber (2013)



Figure 38 – Top of Headframe (2013)



Figure 39 – Headframe, Winder Engine Shed on Right (2012)

## **10.0 HISTORIC INDIVIDUALS ASSOCIATED WITH SONS OF GWALIA**

### **10.1 Herbert Hoover**

Herbert Hoover was born in Iowa in 1874. He was orphaned at age 9 and raised by a Quaker uncle. He studied mining engineering at Stanford and by age 40, he was a successful mine engineer, manager of a number of mining companies throughout the world, and a wealthy businessman. His ability for efficiency resulted in his appointment as 'food administrator' in the United States in 1917, and he headed a World War I relief commission that provided food for millions of people in Europe. He was appointed head of the Department of Commerce in 1920 and, as a Republican, was elected 31<sup>st</sup> President of the United States in 1929. The hardships caused by the Depression resulted in his losing the election to Franklin D. Roosevelt in 1932. After leaving the White House, Herbert Hoover founded the Hoover Library, wrote a number of books of memoirs and political commentary, and returned to humanitarian work during World War II. He headed two commissions on reorganization of the executive branch of government in the 1940s and 1950s. He died in 1964, at the age of 90.

In May 1897, Herbert Hoover came to Western Australia as manager-inspecting engineer for the London and Western Australian Exploration Company, which was associated with Algernon Moreing of Bewick Moreing & Co., a British based mine management company involved with many WA mines.

Herbert Hoover was appointed Superintendent of the Sons of Gwalia mine in March 1898, and took up his position on 1 May. Hoover instigated efficiencies at the mine, including replacing the vertical shaft with an incline. He established the mine as a profitable and efficient operation, employing migrant miners, specifically Italian and Austrian, because they worked hard and would accept a lower wage. He arranged the construction of staff and office buildings including underground manager, the Mine Office, Assay Building and Mine Manager's House. During Hoover's time at Gwalia, the mine employed 500 men.

The mine office was completed in October 1898, at which time the Assay Building was under construction. Herbert Hoover left Gwalia late in November 1898, returning to America before taking up a position in China.

In 1902, Herbert Hoover became a partner in Bewick Moreing & Co. and was put in charge of all the company's world-wide mine management activities.

In 1908 Hoover left Bewick Moreing & Co. to make his millions as an independent mining financier.

### **10.2 Charles Moreing and Edward Hooper**

Charles Algernon Moreing was the senior partner and Edward Hooper a partner in Western Australia of Bewick, Moreing and Company.



Figure 40 – Herbert Hoover  
(c 1930s from Internet)

During the London boom in the promotion of Western Australian gold mining companies from 1894 to 1898 Bewick, Moreing and Company, was the leading London promoter of Western Australian mining companies. During those five years the company promoted, or jointly promoted no less than 67 Western Australian companies, 90 % of which were mining companies or ones associated with mining, and the rest were ones formed for finance property development in the goldfields or in Perth. The Sons of Gwalia was one of the few prospects which developed into a long term mine.

In the early years of the boom Bewick, Moreing arranged in detail the composition of each of the companies it promoted, appointed itself the company's mining consultant, and then left the directors of the mining company to get on with organising the running of the company. Usually it was left to Hooper to appoint a mine manager unless a director's son was sent out from London 'to gain experience'. By about 1897 Bewick, Moreing began to realise that there was money to be made from managing gold mines in addition to the money it made out of promoting them. Therefore for most of the later companies which Bewick, Moreing promoted, the company appointed itself 'manager and consultant'.

In 1904 the failure of Bewick, Moreing to make the cost savings it had promised to the two largest producers on the Golden Mile was a major setback which prevented the company from taking over the management of other independent mines. Nevertheless in 1908 in Western Australia Bewick, Moreing was still the most important mining consultant and mine management company in the industry - in fact it was practically the only one left in the state at that time. In 1911 it still managed 14 mines in WA, two on the Golden Mile and the remainder scattered through the outer goldfields. In addition the company managed two important mines in Broken Hill and a number of gold and copper mines in the Victoria and Queensland which the company's Melbourne office was attempting to revive. Bewick, Moreing's Kalgoorlie office had a large staff of 36, 22 of whom were classified as being 'charged out', meaning that their time was charged to the company's client mining companies. The Sons of Gwalia mine, which for most of its years in production had the largest gold output of any of the mines managed by Bewick, Moreing in Australia, had a staff of 30 from the Superintendent down to the lowly sampler's clerk and included 10 foremen and shift bosses. In addition in 1911 the mine employed 420 miners and surface workers. Other large mines managed by the company such as Great Fingall Consolidated on the Murchison would have required between 15 and 20 staff and probably 100 wage earners.

Bewick, Moreing, one of the few organisations which appeared to offer career paths in mining, was able to pick and chose from the most able of the unemployed. But the company's mines were just as susceptible to spiralling costs as any other mines. By the end of 1915 of the 12 Western Australian mines outside Kalgoorlie-Boulder which the company had managed in March 1911, only four were still in business. They were the Sons of Gwalia, Great Fingall Consolidated, Yuanmi Gold Mines and Oroya Black Range near Sandstone in the Black Range Goldfield. This last one closed in 1917.

One of the unusual but important characteristics of the Sons of Gwalia mine was that for almost the whole duration of the mine's operation it was managed by Bewick, Moreing and Company. The mine's association with Bewick, Moreing was undoubtedly one of the reasons for its operational longevity, but the benefits derived from the association, except for one episode in the late 1930s, were not of the type technical and financial assistance that one might have expected from such a long term relationship. The benefits were derived from the calibre of men which the company attracted to its ranks in Western Australia during the rapid disintegration in the 1910s of the second tier of Western Australian gold mining companies, those which were producing less than 20 thousand ounces a year. It was these men, and in particular those at the company's three isolated northern mines, the Sons of Gwalia near Leonora, Great Fingall Consolidated at Day Dawn in the Murchison and Yuanmi Gold Mines in the East Murchison Goldfield, who were the ones who introduced ground making developments in timber fuel technology and gold metallurgy which succeeded in prolonging the working lives of all three mines, particularly that of the Sons of Gwalia. The other important factor which extended the working life of the Sons of Gwalia was the State Government assistance given to the mine in the form of loans for the execution of important development work.

Bewick, Moreing had a significant effect on the Australian mining industry. One indicator of this may be the number of mining professionals which the company employed in Western Australia before 1930. In a biographical register of mining professionals working in WA between 1892 and 1930, out of a total of 330 entries, no fewer than 152 worked for Bewick, Moreing in WA at one time or other. Such figures can be interpreted in a number of ways but there is no denying that 46% is an impressive figure.

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Engineer and Historian

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– Section 9.5.1 – The Winder Engine

### **Photographs and Diagrams**

Engineers Australia thank the following people and organisations for the use of their photographs and diagrams in this document:

**Shire of Leonora Collection:** Figures 3, 4, 5, 10, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 30, front cover bottom right.

**Intelara Consultants:** Figures 1, 2, 6, 7, 11, 31, 34, 35, 36, 37, 39, front cover top left, front cover bottom left.

**Maitland Heritage Engineering:** Figures 8, 9, 13, 14, 28, 29, front cover top right.

**Dave Collier** – Figure 33

**Gwalia Conservation Study 1985, South Australian Department of Environment and Planning:** Figures 3, 4, 5, 24, 25, 26, 27.

Figures 32 and 40 were sourced from the internet.

### **Compiler**

The compiler of this document is Ian B.G Maitland OAM, FIE Aust CP Eng, a registered Heritage and Conservation Engineer based in Perth. He was Chair of Engineering Heritage Western Australia at time of preparation of this document.



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Places database